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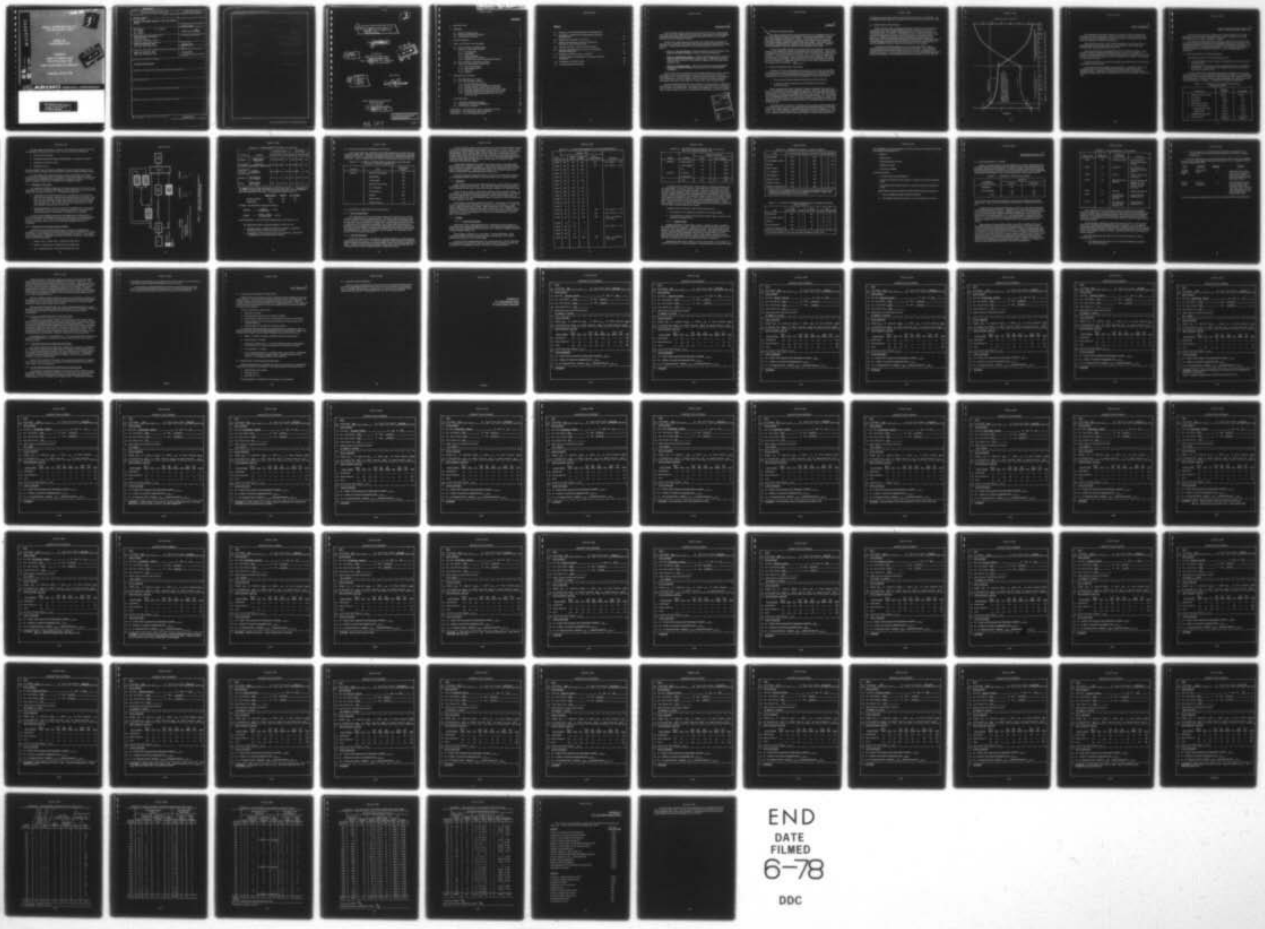

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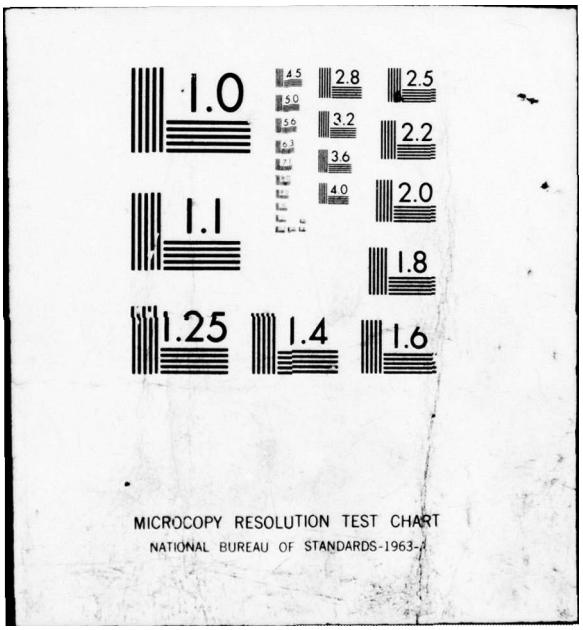
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PRODUCT IMPROVEMENT ANALYSIS, F-4D FIRE CONTROL SYSTEM

January 1971
(Revised October 1972)

Prepared for

OGDEN AIR MATERIEL AREA
Hill Air Force Base, Utah

Under Contract F09603-70-A-2026-QP02

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TABLES

1
INTRODUCTION

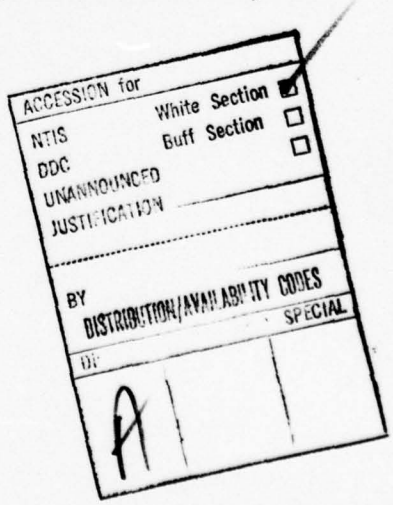
The F-4D Weapon System utilizes the APQ-109/APA-165 Fire Control System (FCS) where air-to-air combat may be encountered. Operational use and field/depot maintenance data indicate that the operational availability of the FCS is not being achieved at the level originally forecast.

In June 1970, ARINC Research Corporation was contracted by the Ogden Air Materiel Area to determine the product improvement potential within the basic design of the FCS. Specific tasks called out in the project Statement of Work were as follows:

- Task 3.1, Data Development — Develop maintenance repair and failure rate data from one depot maintenance facility and two operating bases.
- Task 3.2, Engineering Analysis — Perform engineering analysis on specific problems uncovered in the data development task. Determine and recommend corrective actions for each problem, together with associated implementation costs.
- Task 3.3, Problem Ranking — Rank each corrective action recommended according to potential availability improvement versus probable dollar expenditure.

Data for this study were gathered at the OOAMA Maintenance Facility, Hill Air Force Base; and on one squadron each at Seymour-Johnson Air Force Base and Woodbridge Air Force Base (England). ARINC Research personnel were stationed at each of these sites, not only to collect data on the FCS but to witness testing and maintenance operations at the flight line, avionics shop, and maintenance depot.

The aforementioned tasks have been completed, and the results are reported in this document. The discussions, conclusions, and recommendations are applicable to both the APQ-109 and APQ-109A. The designs and capabilities of these two systems differ in some respects, but not to the extent that would impact on the basic analysis.



2 SUMMARY

2.1 SPECIFIC PROBLEM AREAS

This study revealed that the main contributor to the low availability of the F-4D Fire Control System is electrical instability, a failure mode responsible for about half of all maintenance actions on the system. The design of the FCS is such that even minor changes or fluctuations in component values induced by the operating environment result in significant changes to the output signal. This problem can be corrected by modifications that would not affect present LRU interfaces. Modifications representative of the type needed are recommended in this report.

A related availability problem is associated with FCS calibration. System calibration may be difficult to confirm and maintain under existing policies. The accuracy of calibration can be determined only while the system is being operated under dynamic conditions. Each time the system is accessed, e.g., for the repair or replacement of subsystems or components, many electrical parameters are affected, the system must once again be calibrated, and then placed into full operation before the calibration can be confirmed. Maintenance policies must stress system harmonization and discourage system perturbation.

2.2 PRODUCT IMPROVEMENT POTENTIAL

Analysis of the FCS maintenance data revealed that the system has a potential meantime between maintenance (MTBM) of more than 10 hours. This intrinsic value can be approached if the instability and alignment problems are corrected as recommended herein. An increase in MTBM to a minimum of 10 hours will result in:

a. An increase in system operational availability of about 10 percent

b. A decrease in FCS maintenance cost per flying hour of between 20 and 25 percent.

These improvements will be realizable if all line replaceable units (LRU's) in the FCS are modified to eliminate electrical instability. However, significant improvements can also be achieved by modifying only three LRU's (the indicator control unit, synchronizer, and receiver-transmitter) of the nine in the system. The cost effectiveness of modifying individual LRU's of the FCS is indicated in Figure 2-1, which ranks each LRU of the FCS in terms of potential improvement in operational availability and maintenance cost per flying hour with correction of 1) instability failures, and 2) catastrophic failures.

The right portion of Figure 2-1 ranks the LRU's in terms of improvement potential relative to the correction of all catastrophic and instability failures. While this portion of the figure indicates a significant potential increase in availability – 0.705 to 0.946, with a corresponding decrease in maintenance cost per flying hour of $8.75 to $1.24 – specific product improvement tasks required to realize these benefits were

not apparent from the data collected at either Seymour-Johnson or Woodbridge. All catastrophic failures appear to be random, with no prevalent failure modes or trends.

2.3 MAINTENANCE PROCEDURES

ARINC Research noted a significant difference in MTBM for the FCS between the 335th Tactical Fighter Squadon (Seymour-Johnson AFB) and the 78th TFS (Woodbridge AFB). The MTBM at Woodbridge was 8.33 hours as compared with 4.98 hours for Seymour-Johnson. This difference can be attributed, in part, to the dissimilar maintenance procedures of the two squadrons, as discussed in Section 4.2.5. ARINC Research also observed that the maintenance personnel at Woodbridge were more experienced and higher qualified (Grades 7 and 9) than those at Seymour-Johnson (Grades 5 and 7), but the extent to which that would influence the overall availability of the FCS could not be determined in this analysis.

An increase in MTBM is achieved at a cost of increased MTTR, and an accompanying increase of maintenance cost per operating hour. The availability measure used in this study also showed a decrease, but since consideration is not given to free time (i.e., time in which system is not needed) recommendations regarding fleetwide adoption of the Woodbridge maintenance procedures must be deferred.

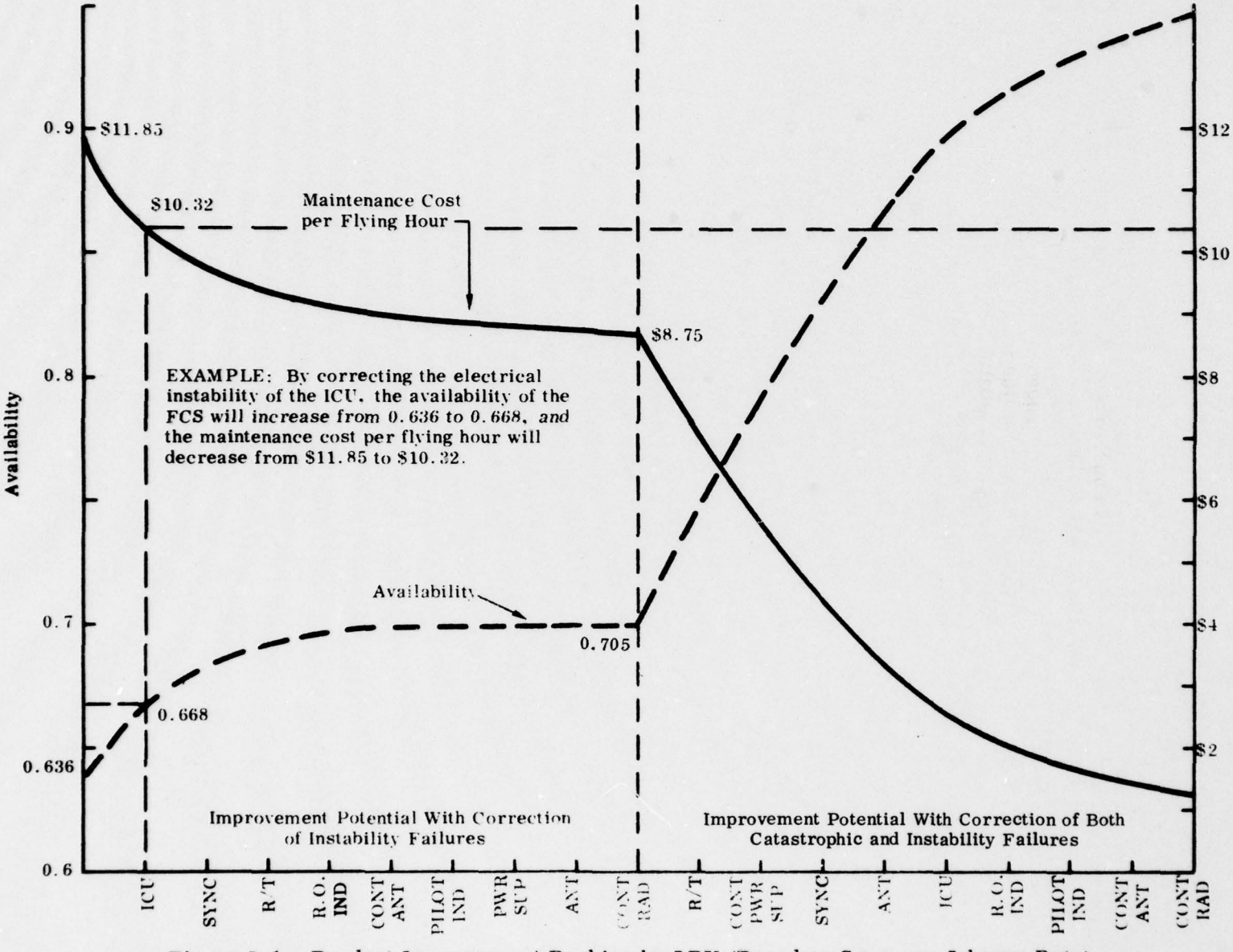


Figure 2-1. Product Improvement Ranking by LRU (Based on Seymour-Johnson Data)

3
STUDY APPROACH

The remainder of this report discusses the means by which the information needed for this study was gathered, reduced, and analyzed; provides details on the conclusions and recommendations summarized in Section 2; and presents all of the basic data subjected to reduction and analysis.

Data collection activities at the OOAMA Maintenance Facility and at the two operating bases are described in Section 4, which discusses how the data were mathematically treated and generally interpreted.

After this data analysis had pinpointed the FCS availability problem as being primarily related to electrical instability (and not, as had been suspected, to intrinsic component deficiencies), an engineering analysis was conducted to determine the extent of the instability problem and how it might best be resolved. This analysis is discussed in Section 5.

Section 6 provides cost and other information associated with the recommended product-improvement activity.

Basic data for this study appear in the appendixes. Appendix A contains FCS maintenance data sheets for individual aircraft at the Seymour-Johnson and Woodbridge bases. Appendix B is a refinement of the data to the squadron level. Appendix C identifies the LRU's of the APQ-109 and APA-165 radar sets by work unit code.

4 DATA COLLECTION AND ANALYSIS

FCS data for this study were collected at the OOAMA Maintenance Facility, Hill Air Force Base; Seymour-Johnson Air Force Base, Goldsboro, N.C.; and Woodbridge Air Force Base, Bentwaters, England.

For reasons that will be discussed, it became evident that only the data from the operational bases would apply to the overall study tasks listed in Section 1. The maintenance facility data were useful in evaluating two hardware areas thought to be problems in the FCS – the antenna and capacitors. Data collection and analysis at the operating bases are discussed in Section 4.1, and at the depot facility in Section 4.2.

4.1 DATA COLLECTION, OPERATING BASES

Data-collection periods at the operating bases were:

a. Seymour-Johnson Air Force Base, July through October 1970, 26 aircraft of the 335th TFS.

b. Woodbridge Air Force Base, October and November 1970, 26 aircraft of the 78th TFS. (These aircraft were assigned such that only 18 could be monitored at any given time.)

The data collected at the operating bases appear in Appendix A and are summarized in Table 4-1. The maintenance reports (item d of Table 4-1) are subdivided according to FCS assembly in Table 4-2, which breaks down the maintenance actions into two categories: 1) those involving system adjustments only, and 2) those involving LRU replacement or repair, or a combination of repair and adjustment.

TABLE 4-1. SUMMARY OF FCS MAINTENANCE DATA, OPERATING BASES

Data Element	Seymour-Johnson	Woodbridge
a. Monitored aircraft hours	43,440	15,364
b. A/C flights	1,184	271
c. Flight hours	1,940.9	483.3
d. Maintenance reports	390	58
e. A/C down-time hours	2,631	1,584.1
Administrative hours	1,523.6	1,212.4
Repair hours	1,107.4	371.7
f. Maintenance man-hours	2,552.5	954.7
g. Period covered	Jul-Oct '70 (4 mo.)	Oct-Nov '70 (2 mo.)

TABLE 4-2. DISTRIBUTION OF APQ-109 LRU MAINTENANCE ACTIONS BY OPERATING BASE

Base	Corr. Action*	Rcvr-Xmtr	Sync	Pwr Cntl	ICU	R.O. Ind	Pilot Ind	Ant	Radar Cntl	Ant Cntl	Total
Seymour-Johnson	Adjust	19	27	3	103	15	4	3	2	10	186
	Repair	54	40	51	28	16	12	30	6	13	250
Woodbridge	Adjust	3	6	3	6	2	1	0	0	0	21
	Repair	10	3	3	6	0	0	7	2	0	31

*Adjust: Adjustment of component(s) was the reported corrective action.
Repair: Removal/repair of LRU/component was the reported corrective action.

4.2 ANALYSIS OF OPERATING BASE DATA

4.2.1 Maintainability

From Table 4-1, maintenance indices for the FCS at the two operating bases are:

	Seymour-Johnson	Woodbridge
$MTTR = \frac{\text{Repair Hours}}{\text{No. of MR's}}$	2.8395 hr	6.4086 hr
$\text{Failures per Flight} = \frac{\text{No. of MR's}}{\text{No. of Flights}}$	0.3294	0.2140
$MTBM = \frac{FLH}{MR} = \frac{\text{Flight Hours}}{\text{No. of MR's}}$	4.9767	8.3328

4.2.2 Availability

ARINC Research developed the following availability indices for this study:

a. Operational Availability (A_O)**

$$= \frac{\text{Flying Hours}}{\text{Flying Hours + Repair Time}}$$

**This measure does not account for free time – the time during which operational use of the system is not required. For avionics used on repetitive missions, such free time may exist. If an improvement in MTBM is achieved at the expense of an increase in MTTR, availiability can improve if the free time absorbs some of the increased maintenance time.

b. Readiness Index (R_I)

$$= 1 - \frac{\text{A/C Downtime Due to FCS (Repair Hours)}}{\text{Total NOR Time}}$$

where total NOR (Not Operationally Ready) Time is 23.5 percent of total monitored FCS flight hours. (Code OOMMER stated that an OOAMA report of January through August 1970 indicates an FCS operational readiness of 76.5 percent.)

c. Maintenance Cost Index (M_I)

$$= \frac{\text{Maintenance Man-Hours}}{\text{Flying Hours}} (\$9)^*$$

From these equations,

	Seymour-Johnson	Woodbridge
$R_I = 1 - \frac{1107.4}{(43,440)(0.235)} = 1 - 0.1085$	0.8915	
$= 1 - \frac{371.7}{(15,364)(0.235)} = 1 - 0.1029$		0.8971
$A_O = \frac{1940.9}{1940.9 + 1107.4}$	0.6367	
$= \frac{483.3}{483.3 + 371.7}$		0.5652
$M_I = \frac{(2552.5)}{(1940.9)}(\$9)$	\$11.84	
$= \frac{(954.7)}{(483.3)}(\$9)$		\$17.78

4.2.3 Failure Analysis

Maintenance action causes can be divided into four categories:

a. Catastrophic failure of hardware

b. System out of calibration

c. A combination of the above

d. Reported malfunction could not be duplicated.

*AFLCM/AFSCM 375-6, Chapter 4, directs that \$9/hr be used as standard field-personnel labor rates.

The last category constitutes 15 percent of all maintenance reports (69 of 448; see Appendix B, Summaries 3 and 4, cols. 1 and 4), and can be attributed to:

a. Electrical intermittents

b. Environmentally induced failure during flight, not apparent on ground

c. Operator error (Pilot or RO)

d. Maintenance error

Since the specific cause of reported malfunctions could not be determined, and no corrective action was taken, these MR's were not used in analysis of failure modes.

For those MR's that reported to the piece-part or component level, only 24 percent of the FCS failures could be attributed to catastrophic failure of hardware, as evidenced by the requirement for removal and/or repair (see Section 5.1). No particular component or piece-part contributed to any significant degree.

4.2.4 Maintenance Procedures

Two significantly different flight-line maintenance procedures for the FCS were observed at Seymour-Johnson and Woodbridge. These differences are best described graphically, as is done in Figure 4-1. The significant points are:

a. Woodbridge uses the AN/APM-307 cart to calibrate the FCS of each aircraft every six months, while Seymour-Johnson uses the AN/AWA-26 cart. The -307 cart energizes, excites, and tests the system in a dynamic state, while the -26 cart is used to align LRU's and test the system in a steady-state condition only. The -26 cart would thus be used to adjust or align any malfunctions detected by the -307 cart.

b. Before installing any LRU on the aircraft, Woodbridge tests it for system compatibility on the F-4D Fire Control Shop mockup. This assures that system homogeneity is maintained to the highest degree possible.

It is the opinion of ARINC Research that the differences in MTBM between Seymour-Johnson and Woodbridge are due to these differences in maintenance policy. As can be seen (Sec. 4.2.1), the cost of this increase in MTBM is an increase in MTTR of more than a factor of two, and a small but significant decrease in availability.

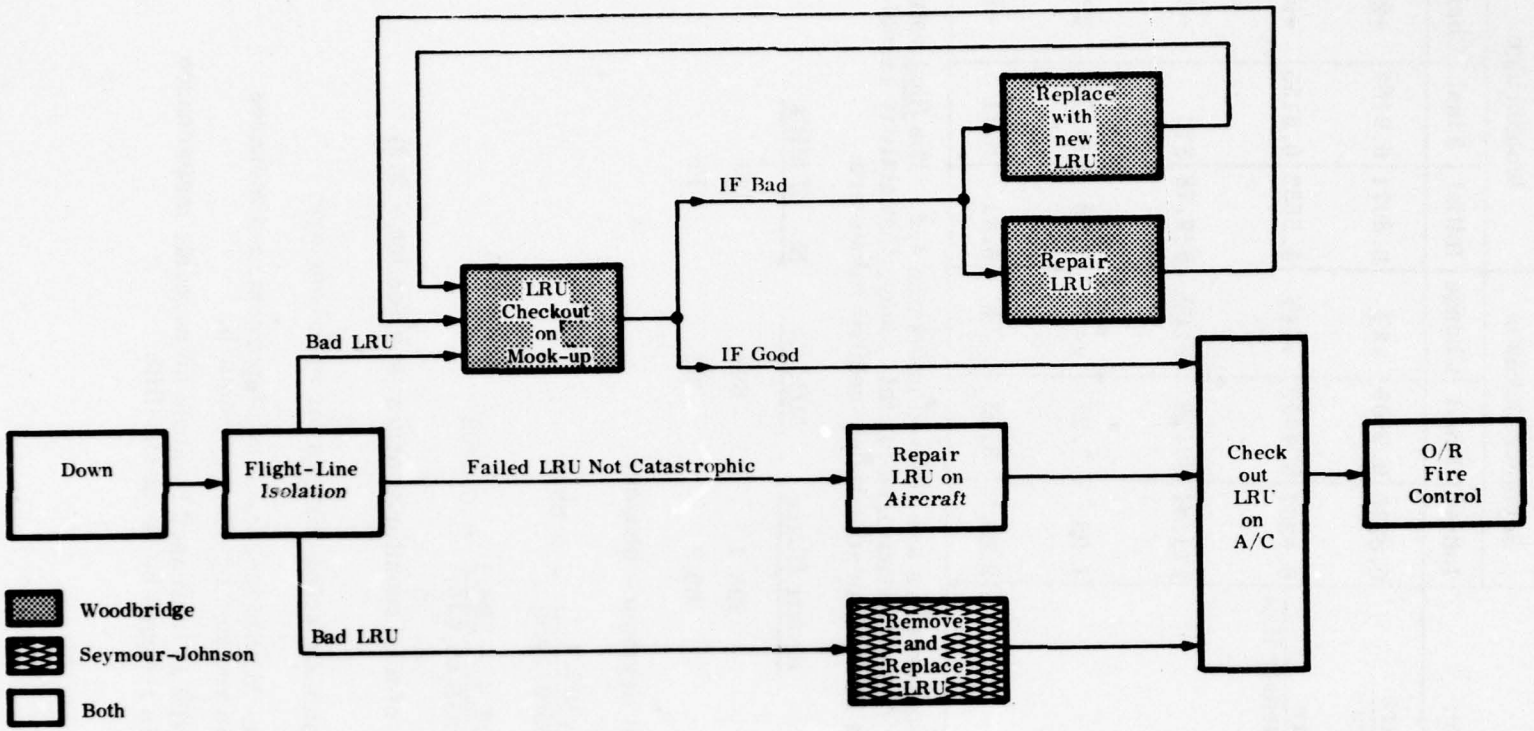
4.2.5 Expected Theoretical Improvement Potential

Assuming that the identified FCS problems – hardware and maintenance procedures – are corrected, the maximum expected results on Readiness, Utilization, Maintenance Cost per Flying Hour, and MTBM are given in Table 4-3. New values for FCS repair hours, maintenance man-hours (M/M/H), and number of maintenance reports are derived as follows:

a. Repair hours = original value – adjustment repair hours

b. M/M/H = original value – M/M/H spent on adjustments

c. MR = original quantity – MR involving adjustments only.



Observations	Seymour-Johnson	Woodbridge
1. Flight Line Isolation Procedures		
AN/AWA-6A Cart Fire Control Bits AN/AWA-26 Cart (when necessary)	Yes	Yes
2. Use AN/APM-307 cart for 180-day radar calibrations.	No	Yes

Figure 4-1. Flight-Line FCS Maintenance Procedures at Seymour-Johnson and Woodbridge

TABLE 4-3. IMPROVEMENT POTENTIAL IN F-4D FCS*

Parameter	Equation	Seymour-Johnson			Woodbridge		
		Initial	Final	Change	Initial	Final	Change
Readiness	$1 - \frac{\text{Repair Hours}}{\text{NOR Hours}}$	0.8915	0.9208	+3%	0.8971	0.9164	+2%
Operational Availability	$\frac{\text{Flying Hrs}}{\text{Flying Hrs + Repair Hrs}}$	0.6367	0.7052	+11%	0.5652	0.6155	+9%
Maintenance Cost per Flying Hour	$\frac{\text{M/M/H}}{\text{Flying Hours}}$	$11.84	$8.76	-26%	$17.78	$14	-21%
MTBM, hr	$\frac{\text{Flying Hours}}{\text{No. of MR's}}$	4.98	7.27	+46%	8.33	10.74	29%
MTTR	$\frac{\text{Repair Time}}{\text{No. of MR's}}$	2.84	3.03	+7%	6.41	6.71	+5%

*The initial values for these parameters are derived in Section 4.2. The final values are derived by subtracting, from the data base for this study, that activity associated with adjustments of the FCS. The adjustment-related values are:

	Repair Hours	M/M/H	No. of MR's
Seymour-Johnson	298.1	698	123
Woodbridge	69.8	202	13

Example: FCS Readiness at Seymour-Johnson:

$$R_I(\text{initial}) = 1 - \frac{1,107.4}{0.235(43,440)} = 0.8915$$

$$R_I(\text{final}) = 1 - \frac{1,107.4 - 298.1}{0.235(43,440)} = 0.9208$$

where NOR Hours = 23.5% of total monitored hours (see Section 4.2.2).

The significant maximum expected changes for each base are:

a. Seymour-Johnson: MTBM increased by 46 percent, maintenance cost/flying hour is reduced by about one-fourth.

b. Woodbridge: MTBM is increased by about 30 percent, maintenance cost/flying hour is reduced by about one-fifth.

4.3 DATA COLLECTION, MAINTENANCE FACILITY

F-4D repair data were collected at the OOAMA Maintenance Facility from June through November 1970. These data pertained to the repair, maintenance, and refurbishment of all LRU's, assemblies, and subassemblies of the APQ-109 and APA-165 radar sets. Table 4-4 summarizes the number of maintenance actions for each LRU.

TABLE 4-4. NUMBER OF MAINTENANCE ACTIONS AT HILL AFB FOR FCS LRU's, JUNE-NOVEMBER 1970

Radar Set	LRU	Maintenance Actions
APQ-109	Receiver/Transmitter	375
	Synchronizer	525
	Power Supply	300
	Indicator Control Unit	380
	R.O. Indicator	43
	Pilot Indicator	36
	Antenna	850
	Radar Control	75
	Antenna Control	19

4.4 ANALYSIS OF MAINTENANCE FACILITY DATA

4.4.1 Data Characteristics

FCS maintenance data from the OOAMA Maintenance Facility do not correlate with data collected at the two operating bases. The most readily discernible reason is that a great deal of refurbishment and preventive maintenance is accomplished at the base while the actual repairs are being made. Thus the depot data are not realistic indicators of FCS operational availability, and for that reason the information gathered at the operating bases served as the general basis for analysis in this study. The depot data were useful in examining three apparent problem areas in the FCS: the time discriminator, capacitors in general, and the antenna. The remainder of this section will be devoted to these topics.

4.4.2 Time Discriminator

It was noted that the time discriminator (assembly A3003) had a high component replacement rate at the depot. A dc stress analysis by ARINC Research revealed that board circuitry is being operated at stresses higher than 50 percent (the design rule of thumb). Subsequent measurements performed at the depot on an operating radar set confirmed that the circuit is being operated at a high stress value.

In the time discriminator, seven capacitors are rated for 150W Vdc and are used as part of the decoupling networks in plate circuits using a 150 Vdc B+ supply. These capacitors are C0002, C0006, C0031, C0034, C0038, C0041, and C0045. During normal operation, when a quiescent plate current is flowing, the capacitors have an applied voltage of less than 150 Vdc due to the voltage drop in the associated resistor in series with the plate current path. If, however, the associated tube should fail in a mode that would cause the plate current to stop flowing, the capacitors would experience their full rated voltage.

During normal operation the voltage stress ratios of these capacitors range from 0.73 to 0.97, as shown in Table 4-5. Measurement made on an APQ-109 simulator at Hill AFB verified the calculations in those cases of high stress (70 to 75 percent) in normal operation. C0038 and C0045 appear to be stressed to their rated limits, as indicated by measured data and by calculations.

The high component-replacement problem in the time discriminator assembly is not being experienced in the field, so this investigation was not pursued further.

4.4.3 Capacitors

APQ-109/APA-165 data at the OOAMA Maintenance Facility indicate a high rate of capacitor replacement in the FCS. All of the usual capacitor failure modes have been evidenced, but one mode – electrolytic leakage – appears to be inordinately high.

Table 4-6 shows capacitor replacement quantities during the subject period. As can be seen, 30 percent of all failures were due to electrolytic leakage. This failure mode will evidence itself in operating equipment as either reduced capacitance or increased power factor, and will eventually cause the capacitor to fail catastrophically by either opening or shorting.

This problem is not being evidenced in the field. Examination of data collected at the two operating bases did indicate a high failure rate of capacitors. Further, the types of capacitors replaced as "leaky" varied considerably, from hermetically sealed oil-impregnated to hermetically sealed wet-tantalum types. ARINC Research could not verify that all capacitors reported as "leaky" were actually leaking. Since this problem could not be duplicated or verified at the operating bases, no further effort was expended on it.

4.4.4 Antenna

4.4.4.1 Failure Data Analysis

The antenna (WUC 74730) induced the most maintenance actions among FCS assemblies at the OOAMA Maintenance Facility. Data analysis and discussions with facility personnel indicated that the antenna feed horn represents a significant problem (arcing, burning, pitting, etc.).

These antenna problems were not verified at the operating bases, which recorded (during the respective survey periods) a combined total of 40 antenna maintenance actions for 1,455 aircraft flights.

A review of the operating base data, the reported problem, and the subsequent fix indicated that no more than 10 of the 40 actions could be a result of arcing; only one of the 10 was identified as "burnt", the other 9 as "possible burnts".

TABLE 4-5. CAPACITOR STRESSES IN FCS TIME DISCRIMINATOR

Cap. Symbol	Voltage, volts				Remarks
	Rated	Applied (Calc.)	Applied (Meas.)	(Calc.) w/Tube Failure	
C0002	150	114	122	150	S.R. (meas.) = 0.81
C0006	150	114	122	150	S.R. (meas.) = 0.81
C0010	400	300	238		
C0012	200	150	118		
C0013	30	18	6		
C0016	200	150	123		
C0017	30	18	5		
C0018	400	250	120		
C0021	400	250	123		
C0023	600	250	1.3		
C0026	30	8.7	2.0		
C0027	200	150	120		
C0029	10	5.6	2.1		
C0031	150	96	120	150	S.R. (meas.) = 0.80
C0034	150	109	110	150	S.R. (meas.) = 0.73
C0038	150	132	150	150	S.R. = 1.0 (meas.), 0.88 (calc.)
C0040	30	4.4	5		
C0041	150	114			S.R. (calc.) = 0.76
C0043	100	9	3		
C0044	100	72	7		
C0045	150	146	150	150	S.R. = 1.0 (meas.), 0.97 (calc.)

TABLE 4-6. CAPACITOR REPLACEMENTS FOR F-4D FCS AT HILL AFB, JUNE-NOVEMBER 1970

Radar	Assembly	Capacitors Replaced		
		Total	Due to Leakage	
APQ-109	Synchronizer	235	58	(25%)
	Power Supply	38	15	(40%)
	ICU	113	48	(42%)
APA-165	Computer	55	10	(18%)
	Transmitter	48	17	(35%)
	Total	489	148	(30%)

To supplement the collected data, ARINC Research requested additional AFM 66-1 information. Two AFLC reports, 3-LOG-K261 and 4-LOG-K261, both dated 31 October 1970, were received and reviewed. Table 4-7 summarizes the 3-LOG and the 4-LOG information. The 3-LOG data confirms the information collected at Seymour-Johnson and Woodbridge to the degree that the synchronizer, power-supply control, receiver-transmitter, and indicator control are the top four LRU's in terms of the number of maintenance actions. The 4-LOG is similar except that the antenna does rank in the top four in terms of shop actions (the indicator control drops to fifth). Note also in Table 4-4 that the antenna is the highest NRTS item. Table 4-8 shows, based on 3- and 4-LOG data, the average number of actions per month for the five FCS LRU's ranking highest in this regard.

Conclusions from this portion of the antenna study are that:

a. The antenna is not a significant contributor to FCS unavailability.

b. The antenna does consume the largest percentage of depot resources, both manpower and supply items.

4.4.4.2 System Arcing

OOAMA Maintenance Facility policy dictates complete teardown, inspection, and refurbishment of the antenna. Field and shop maintenance policy calls for teardown only to the level needed to accomplish the repair. Depot maintenance would therefore surface mechanical or electrical defects that would appear to degrade the system, while field/shop maintenance would involve only the repair of out-of-specification or catastrophic failures. Since a large quantity of burned or arced parts are being found at the depot the question becomes how much the system can be degraded by arcing before system performance becomes unacceptable.

Although this study did not attempt to answer that question, some insight may be gained by analysis of "could not duplicate" maintenance actions at Seymour-Johnson

TABLE 4-7. SUMMARY OF AFM-66-1 DATA ON APQ-109

LRU	3-LOG-K261*	Rank	4-LOG-K261**	Rank	NRTS+
Synchronizer	5675	1	3162	1	38
Power Supply Control	4010	3	2120	2	39
Antenna	2890	5	1857	4	105
Radar Control	471	9	109	9	9
R.O. Indicator	1189	6	447	6	7
Pilot Indicator	723	8	300	8	7
Antenna Control	934	7	396	7	5
Indicator Control	3520	4	630	5	20
Receiver-Transmitter	4101	2	1933	3	2

*Flight-line FCS maintenance data for 12-month period ending 31 October 1970.
**Avionics shop maintenance data for 12-month period ending 31 October 1970.
+Not Repairable This Station, LRU sent to depot.

TABLE 4-8. AVERAGE NUMBER OF MAINTENANCE ACTIONS PER MONTH FOR FCS LRU'S

LRU	3-LOG Actions/Mo.*	Rank	4-LOG Actions/Mo.*	Rank	Pct NRTS	Rank
Synchronizer	473	1	264	1	1.2	4
Power Supply Control	334	3	177	2	1.8	3
Antenna	241	5	155	4	5.6	1
Control Indicator	293	4	53	5	3.1	2
Receiver-Transmitter	342	2	161	3	0.1	5

*Total items divided by 12 for one-year period ending 31 October 1970.

and Woodbridge. Of all such actions, 45 percent could have been caused by arcing. The reported malfunctions were:

- Mag out
- Weak returns
- Weak targets past 18 miles
- Breaks L/O easily
- Loss mag at altitude

Of those 45 percent:

- 55 percent reported next flight OK
- 32 percent had the R/T unit repaired or replaced on the next maintenance action
- 9 percent had the antenna repaired or replaced on the next maintenance action.

ARINC Research thus concludes that while system arcing is occurring, it:

a. Does not significantly affect system availability

b. Does degrade system performance, but to what degree is not known.

5
ENGINEERING ANALYSIS

5.1 FCS ADJUSTMENT VS. REPAIR

Table 5-1 (see Summaries 1 and 2 of Appendix B for further details) shows FCS corrective actions at the component level at Seymour-Johnson and Woodbridge for the previously stated observation periods. At Seymour-Johnson, adjustments comprised almost 80 percent of the corrective actions at the component level. The corresponding percentage at Woodbridge was lower but still significant, approaching 50 percent.

TABLE 5-1. COMPONENT CORRECTIVE ACTIONS

Component Corrective Action	Quantity at	
	Seymour	Woodbridge
Adjustment	378	23
Remove/Repair	99	31
Total	477	54

The most numerous component adjustments occurred in the indicator control unit (WUC 74780). Table 5-2 shows the number of adjustments by subassembly within the ICU.

ARINC Research evaluated FCS adjustment sensitivity on the APQ-109 mockup at the OOAMA Maintenance Facility. During the test it was noted that the potentiometers used in the ICU were subject to resistance changes (when the potentiometer lock nut was locked down) under vibration and shock environments. The vibration and shock levels were human-induced, i.e., by bumping equipment, tapping potentiometers, etc. It was found that the oscilloscope (pilot and R.O.) output symbols would usually be displaced by as much as a quarter-inch after the potentiometers were tapped.

The potentiometer specifications called out are MIL-R-12934 and MIL-R-94. The ARINC Research interpretation of these specifications is that MIL-R-12934 allows a 10 percent resistance change and MIL-R-94 allows a 7 percent change under a combination of shock and vibration environments. A subsequent engineering analysis of selected circuitry indicated that a 7 to 10 percent change would indeed be manifested by a scope symbol movement, in many cases as much as a quarter-inch. Since the potentiometers are apparently operating within the specified limits, additional analysis was performed to see if the adjustment circuitry could be modified to compensate for the apparent effects of shock and vibration. Sections 5.2.1 through 5.2.6 give the results of analyses conducted on seven ICU subassemblies.

TABLE 5-2. ICU SUBASSEMBLY ADJUSTMENTS

Subassembly	No. of Adjustments	Component Circuit Symbol	Remarks
A3701	28	R1, R3, R8, R1412	R3 & R8 adj. 26 times (A-gun centering adj.)
A3707	33	R3, R7, R8	R3 & R8 adj. 32 times (A-gun centering adj.)
A3709	11	R4, R11	R4 adj. 10 times (El. strobe adj.)
A3715	48	R7, R8, R12, R15, R25, R27	R8 adj. 20 times (El. strobe vert. ctr.); R25 adj. 10 times (acquis. symbol zero adj.)
A3718	13	R15, R25	Range amplitude adj.
A3723	35	R1, R2, R6, R11, R14, R23, R24, R28, R32	B-gun deflection amplifier (pilot)
A3724	40	R1, R2, R6, R11, R14, R23, R24, R28, R32, R37	B-gun deflection amplifier (R.O.)

In the APQ-109, power to the entire system is provided by power supplies located in a single LRU. An out-of-tolerance voltage in this LRU could therefore be expected to affect several circuits in the system and produce numerous malfunction symptoms. An examination of field maintenance reports indicates that the adjustments made to the system were, in most cases, indeed the result of a single specific malfunction symptom.

All maintenance, calibration, and aircrew check procedures contain specific steps for the measurement and adjustment of the dc voltages. In some cases the adjustments involve replacement of the applicable voltage regulator tube (this accounts for the noted replacement of 14 VR tubes). The maintenance reports show that adjustments to power supply voltages are made in response to reported out-of-tolerance dc voltage symptoms.

Dc power supply drift was ruled out as a primary contributor to system instability since:

a. The adjustments were made to correct specific malfunction symptoms that occurred randomly.

b. The dc voltages are monitored during maintenance and operation, and specific corrective steps are dictated should an out of tolerance condition be indicated.

Of the 130 components removed and replaced (see Table 5-1) the most significant items were the voltage regulator tubes and crystal diodes. The investigation of these devices is summarized below.

Part	Assembly	Quantity	Analysis
Voltage regulator tubes	Power supply chassis	14	Replacement was made to correct out-of-tolerance power supply voltage, considered an adjustment-type maintenance action.
Crystal diodes	Receiver-transmitter	14	This represents a failure rate of 2.0%/1000 hours. Published failure rates vary from 2.5% to 17%/1000 hours (depending on device and operating stress). No further action taken.

The rate of component replacement in the FCS is considered within acceptable limits.

5.2 ELECTRICAL INSTABILITY ANALYSES

5.2.1 B-Gun Deflection Amplifier

A worst case analysis was performed on the B-gun deflection amplifiers and associated adjustments (A3723-R1, R14, R23, R28; A3724-R1, R14, R23, R28). The objective of this analysis was to determine:

a. The range of adjustment necessary for all calibration potentiometers involved, and

b. Those components whose parameters, if varied, would most affect the stability of the outputs.

5.2.1.1 R1, R28 Amplitude Adjustments

The range of adjustment of R1 and R28 to correct for differences in gain between the B-gun deflection amplifiers due to initial component tolerances and worst case end-of-life parameter changes was computed to be ±37.5K from center. A ±25K adjustment will be adequate except in a few extreme cases when the worst case is approached. This narrower adjustment would increase amplifier stability, but is not feasible with presently used components. R1 and R28 are wirewound potentiometers, the parameters of which tend to change more under shock and vibration than those of composition or cermet types. ARINC Research recommends the substitution of one of the latter types for the wirewound potentiometers.

5.2.1.2 R14, R23 Centering Adjustments

The range presently provided by the R14 and R23 centering adjustments was found to be the correct level required and no reduction is recommended. However since these resistors are wirewound potentiometers, the same recommendation as in 5.2.1.1 would also apply here.

5.2.1.3 Component Parameter Sensitivity

The effect of variations in the values of individual component parameters of the B-gun amplifier was determined by varying each parameter one at a time and calculating the output values. The most sensitive parameters are the amplification factors of the electron tubes, particularly the tubes used in the first stages of each amplifier. It is recommended that the feasibility of purchasing these tubes to a specification that would require matched parameters between both dual-triode sections be studied. A guaranteed minimum spread in tube parameters might allow a decrease in the range --and therefore an increase in the stability--of the centering adjustment.

Two of the more sensitive resistors, R19 and R21 in the vertical deflection circuit, are not the same type even though they are counterparts in a symmetrical circuit. R19 is an RN70C, while R21 is an RN75C. The counterpart resistors in the other identical horizontal deflection circuit on this board (R46 and R48) are both RN75C's. Field data indicated that fewer centering adjustments have been needed in the horizontal amplifier than on the vertical amplifier. It is recommended that R19 be changed to an RN75C type.

5.2.2 Elevation Amplifier Adjustment (A3709-R4)

Five resistors in the elevation strobe circuit on A3709 are MIL-R-11 composition types (RC20GF) with critical values. It is recommended that these resistors (R1, R2, R3, R5, and R8) be changed to a more stable type, such as MIL-R-10509 film resistors. Such a change would:

a. Improve the stability of the circuit under varying environmental conditions and with time;

b. Decrease the range of adjustment of the "EL V Amp" potentiometer, and therefore increase adjustment stability.

The range of adjustment of R4 is greater than needed, thus making the adjustment unnecessarily sensitive and consequently more susceptible to change under environmental conditions. It is recommended that some fixed resistance be placed in series with R4, thereby decreasing its sensitivity.

Factors to be considered in determining the values of the resistors to be used in a modified voltage divider network include the accuracy of the input signal (output of A3709-Q1), and the nominal output value required. The accuracy of the input signal will determine the range of an adjustment required, and will be the result of considering:

a. The accuracy and stability of transducers B5008 and B5011 and the associated summing network composed of R4939 and R4940;

b. The accuracy and stability of the amplifier circuit composed of A3709Q1 and associated resistors.

A minimum range of adjustment of ±5% was derived after considering the above. It is recommended that the voltage divider be redesigned for a ±10% adjustment range. This must be accompanied by the previously recommended replacement of the composition-type resistors in the A3709-Q1 amplifier circuit. This change will result in a 10-to-1 improvement in the stability of the elevation vertical amplifier adjustment. The required nominal value of the voltage divider, while it is the determining factor in the design of the device, does not influence the range of adjustment necessary and therefore was not derived in this effort.

5.2.3 Elevation Strobe Vertical Center (A3715-R8)

The range of adjustment for A3715-R8 is greater than necessary considering the worst case offsets that would have to be corrected due to purchase tolerances and end-of-life values of components in the elevation strobe circuit. As a result of this excessive adjustment range, the adjustment sensitivity is also greater than necessary. Worst-case movement of the potentiometer setting due to shock and vibration would result in a ±0.25-inch deflection.

Changing the centering potentiometer from 100 to 50 kilohms, with a 25-kilohm resistor on each side of the potentiometer, would decrease the sensitivity. The range of adjustment would be adequate to compensate for the computed worst case offsets in the circuit, and would decrease the worst case deflection shift due to adjustment instability to ±0.125 inch.

ARINC Research recommends replacement of the present 2W335 and 2W336 grown-junction transistors with types 2N2218A and 2N2219A, respectively. The latter transistors are planar types and therefore more stable. They are priced competively with the devices now being used in the system and are packaged in the same TO-5 can, and thus would not necessitate a printed circuit redesign. It is recommended that this change be considered throughout the system wherever 2W335 or 2W336 devices are used, this being advisable not only from a performance standpoint but also from the standpoint of logistics (the 2N2218A and 2N2219A being newer and more readily available devices).

The use of TN70E instead of RL20 type resistors in the deflection amplifiers of the horizontal and vertical signal switch assemblies (A3702 and A3708) would improve the stability of these circuits and would be consistent with the use of MIL-R-10509 resistors in other critical circuits in the system.

With the aforementioned changes, the range of adjustment provided for A-gun horizontal and vertical amplifier adjustments (A3702-R13, R18; A3708-R13, R18) could be decreased and therefore would be more stable under shock and vibration environments.

5.2.4 R_{min}/R_A Amplitude Adjustment (A3718-R15, R25)

An analysis of the R_{min}/R_A vertical circuit indicates that the range of adjustment for the R_A amplifier (R15) and the R_{min} amplifier (R25) is greater than required for worst case distribution and variations of the component parameters. It is recommended that the present 25-kilohm potentiometers be replaced by 5-kilohm potentiometers with two fixed resistors in series. The value of the revised resistor would be such that the adjustment range would center about the required mean value. The determination of the mean value is beyond the scope of this effort; it would be accomplished during the redesign effort required to implement this recommendation.

Both potentiometers are wirewound types. It is recommended that consideration be given to changing these to composition or cermet types, for the same reason as previously stated.

5.2.5 Acquisition Symbol Zero Adjustment (A3715-R25)

The range of adjustment of A3715-R25 is greater than necessary to compensate for initial part-to-part parameter differences and changes during the equipment lifetime. Calculation indicates that under worst case conditions an adjustment range of ±10 kilohms would be adequate; presently the range is ±50 kilohms. A reduction in the value of the potentiometer from 100 to 20 kilohms with two 40.2-kilohm fixed resistors in series is recommended.

Resistor R24 of A3715, which is part of the summing network for the "Age Sym Zero" circuit, is an RL07 type. A change to an RN60E would improve the stability of the circuit, and is recommended.

5.2.6 A-Gun Centering Adjustments (A3701-R3, R8; A3707-R3, R8)

Considering the allowable distribution for tube plate current, maximum undeflected spot position for the CRT, and worst case distribution of the other component parameters, it was calculated that the A-gun centering adjustment should have a voltage range of ±3.5V. Presently a ±10V range is used. A reduction in the range

of adjustment would result in a less sensitive control that would cause the output to be more stable when the equipment undergoes shock and vibration.

It is therefore recommended that the 50-kilohm centering potentiometers R3 and R8 in both A3701 and A3707 be replaced with a 25 kilohm potentiometer, with two 2.15-kilohm fixed resistors in series (one each to the fixed terminals).

6 COST ANALYSIS

6.1 ELECTRICAL INSTABILITY CORRECTION

ARINC Research estimates the cost of developing and documenting the required design changes to correct the FCS instability problem would be within $200,000. The estimate assumes that mechanical and electrical interfaces between existing FCS modules and LRU's would not be affected by any design modifications. This constraint would limit the design modification to the lowest subassembly level and still provide the improvement required.

The cost expenditure would provide:

a. Redesign of modules

b. Environmental and bench proof testing of modules

c. Environmental testing of LRU's having modified module(s) incorporated

d. ECP's together with supporting documentation, for procurement of the modified modules.

e. Revision pages to the applicable Technical Orders.

Provided that interchangeability of modules and LRU is maintained, direct or indirect costs other than the aforementioned $200,000 would be minimal. Major cost elements and the impact thereon of the redesign program would be as follows:

a. Spares - No effect, possibly a reduction in spares requirements.

b. Documentation - No effect.

c. Hardware production cost - Cost of each affected module would probably not increase over 5 percent of existing cost in production quantities.

d. Test equipment - No effect.

e. Non-recurring logistics cost - Minimal effect, no new parts or assemblies will be introduced into the supply system. Modified modules will be, however, so accounting practices will be affected.

6.2 MAINTENANCE PROCEDURE MODIFICATION

ARINC Research does not anticipate any cost to the government in initiating the maintenance procedures recommended. The requirements for each squadron are:

a. APQ-109/APA-165 mockup

b. AN/AWA-26 cart

c. AN/APM-307 cart

These equipments are believed to be available to each squadron.

6.3 COST RECOVERY ESTIMATE

Table 4-3 shows that elimination of the FCS electrical instability problem would result in an approximate decrease of 20 to 25 percent in maintenance cost per flying hour. Assuming conservatively, a saving of $3. per flying hour, the potential annual decrease for 500 aircraft, each flying 300 hours per year, would be $450,000.

APPENDIX A
FCS MAINTENANCE DATA
BY INDIVIDUAL AIRCRAFT

AIRCRAFT DATA SUMMARY

1. UNIT

1a. Tail Number 244 1b. Type of Fire Control APQ-109

2. DATA SOURCE

2a. Base Site Seymour-Johnson 2b. Sqdn. No. 335

2c. Hrs. End Monitor 6744 2d. Date 10/8/70

2e. Hrs. Start Monitor 4632 2f. Date 7/12/70

2g. Total Monitor Hrs. 2112

2h. ARINC Research Monitoring Personnel
M. Hutton, L. Larsen

3. DATA SUMMARY

3a. Flights 46 3b. Flight Hrs. 77.9 3c. MRA's 16 3d. Maint. Manhours 109.2

3e. FC Downtime Hrs. 84.7 3f. Admin. Time Hrs. 37.8 3g. Repair Time Hrs. 46.9

4. LRU SUMMARY, APQ-109

Type of Action	Rcvr/ Xmtr	Sync	P.S.	Cont. Ind.	Ind. (RO)	Ind. (Pilot)	Ant.	Cont. Radar	Cont. Ant.	Total
4a. Adjustments	3	1		7		1				12
4b. Repair/Replaced	3	1		1	3		1		2	11
4c. Total	6	2		8	3	1	1		2	23

4d. AN/APA-165 LRU Failures: 2

5. PARTS SUMMARY

5a. No. of MR's with Component Part Information Available 12.

5b. No. of MRA's Corrected by Adjustment Only 9.

5c. No. of Component Parts: Adjusted 22; Repaired/Replaced 5.

6. REMARKS

AIRCRAFT DATA SUMMARY

1. UNIT

1a. Tail Number 261 1b. Type of Fire Control APQ-109

2. DATA SOURCE

2a. Base Site Seymour-Johnson 2b. Sqdn. No. 335

2c. Hrs. End Monitor 6024 2d. Date 9/8/70

2e. Hrs. Start Monitor 4632 2f. Date 7/12/70

2g. Total Monitor Hrs. 1392

2h. ARINC Research Monitoring Personnel
M. Hutton, L. Larsen

3. DATA SUMMARY

3a. Flights 27 3b. Flight Hrs. 38.7 3c. MRA's 6 3d. Maint. Manhours 42.5

3e. FC Downtime Hrs. 184.2 3f. Admin. Time Hrs. 166.4 3g. Repair Time Hrs. 17.8

4. LRU SUMMARY, APQ-109

Type of Action	Rcvr/ Xmtr	Sync	P.S.	Cont. Ind.	Ind. (RO)	Ind. (Pilot)	Ant.	Cont. Radar	Cont. Ant.	Total
4a. Adjustments		2		1						3
4b. Repair/Replaced		1	1						1	3
4c. Total		3	1	1					1	6

4d. AN/APA-165 LRU Failures: 1

5. PARTS SUMMARY

5a. No. of MR's with Component Part Information Available 4.

5b. No. of MRA's Corrected by Adjustment Only 3.

5c. No. of Component Parts: Adjusted 8; Repaired/Replaced 1.

6. REMARKS

AIRCRAFT DATA SUMMARY

1. UNIT

1a. Tail Number 266 1b. Type of Fire Control APQ-109

2. DATA SOURCE

2a. Base Site Seymour-Johnson 2b. Sqdn. No. 335

2c. Hrs. End Monitor 6816 2d. Date 10/11/70

2e. Hrs. Start Monitor 4632 2f. Date 7/12/70

2g. Total Monitor Hrs. 2184

2h. ARINC Research Monitoring Personnel
M. Hutton, L. Larsen

3. DATA SUMMARY

3a. Flights 57 3b. Flight Hrs. 96.1 3c. MRA's 22 3d. Maint. Manhours 197.8

3e. FC Downtime Hrs. 190.4 3f. Admin. Time Hrs. 83.8 3g. Repair Time Hrs. 106.6

4. LRU SUMMARY, APQ-109

Type of Action	Rcvr/ Xmtr	Sync	P.S.	Cont. Ind.	Ind. (RO)	Ind. (Pilot)	Ant.	Cont. Radar	Cont. Ant.	Total
4a. Adjustments	2	1		7			1			11
4b. Repair/Replaced	5	2	8	1	1		5			22
4c. Total	7	3	8	8	1		6			33

4d. AN/APA-165 LRU Failures: 0

5. PARTS SUMMARY

5a. No. of MR's with Component Part Information Available 12.

5b. No. of MRA's Corrected by Adjustment Only 6.

5c. No. of Component Parts: Adjusted 27; Repaired/Replaced 7.

6. REMARKS

AIRCRAFT DATA SUMMARY

1. UNIT

1a. Tail Number 271 1b. Type of Fire Control AQP-109

2. DATA SOURCE

2a. Base Site Seymour-Johnson 2b. Sqdn. No. 335

2c. Hrs. End Monitor 6744 2d. Date 10/8/70

2e. Hrs. Start Monitor 4656 2f. Date 7/13/70

2g. Total Monitor Hrs. 2088

2h. ARINC Research Monitoring Personnel
M. Hutton, L. Larsen

3. DATA SUMMARY

3a. Flights 50 3b. Flight Hrs. 80.9 3c. MRA's 24 3d. Maint. Manhours 119.9

3e. FC Downtime Hrs. 150.3 3f. Admin. Time Hrs. 97.4 3g. Repair Time Hrs. 52.9

4. LRU SUMMARY, APQ-109

Type of Action	Rcvr/ Xmtr	Sync	P.S.	Cont. Ind.	Ind. (RO)	Ind. (Pilot)	Ant.	Cont. Radar	Cont. Ant.	Total
4a. Adjustments	2	2		4						8
4b. Repair/Replaced	4	6	4				3	2		9
4c. Total	6	8	4	4			3	2		27

4d. AN/APA-165 LRU Failures: 0

5. PARTS SUMMARY

5a. No. of MR's with Component Part Information Available 11.

5b. No. of MRA's Corrected by Adjustment Only 7.

5c. No. of Component Parts: Adjusted 20; Repaired/Replaced 13.

6. REMARKS

AIRCRAFT DATA SUMMARY

1. UNIT

1a. Tail Number 272 1b. Type of Fire Control APQ-109

2. DATA SOURCE

2a. Base Site Woodbridge, England 2b. Sqdn. No. 78

2c. Hrs. End Monitor 7848 2d. Date 10/26/70

2e. Hrs. Start Monitor 7180 2f. Date 11/23/70

2g. Total Monitor Hrs. 668

2h. ARINC Research Monitoring Personnel

3. DATA SUMMARY

3a. Flights 20 3b. Flight Hrs. 37.9 3c. MRA's 3 3d. Maint. Manhours 78.9

3e. FC Downtime Hrs. 543.4 3f. Admin. Time Hrs. 517.1 3g. Repair Time Hrs. 26.3

4. LRU SUMMARY, APQ-109

Type of Action	Rcvr/ Xmtr	Sync	P.S.	Cont. Ind.	Ind. (RO)	Ind. (Pilot)	Ant.	Cont. Radar	Cont. Ant.	Total
4a. Adjustments		1			1					2
4b. Repair/Replaced								1		1
4c. Total		1			1			1		3

4d. AN/APA-165 LRU Failures: 1

5. PARTS SUMMARY

5a. No. of MR's with Component Part Information Available 2.

5b. No. of MRA's Corrected by Adjustment Only 1.

5c. No. of Component Parts: Adjusted 1; Repaired/Replaced 1.

6. REMARKS

AIRCRAFT DATA SUMMARY

1. UNIT

1a. Tail Number 588 1b. Type of Fire Control APQ-109

2. DATA SOURCE

2a. Base Site Seymour-Johnson 2b. Sqdn. No. 335

2c. Hrs. End Monitor 6744 2d. Date 10/8/70

2e. Hrs. Start Monitor 6672 2f. Date 10/5/70

2g. Total Monitor Hrs. 72

2h. ARINC Research Monitoring Personnel
M. Hutton, L. Larsen

3. DATA SUMMARY

3a. Flights 5 3b. Flight Hrs. 5.4 3c. MRA's 1 3d. Maint. Manhours 10.6

3e. FC Downtime Hrs. 7.6 3f. Admin. Time Hrs. 2.3 3g. Repair Time Hrs. 5.3

4. LRU SUMMARY, APQ-109

Type of Action	Rcvr/ Xmtr	Sync	P.S.	Cont. Ind.	Ind. (RO)	Ind. (Pilot)	Ant.	Cont. Radar	Cont. Ant.	Total
4a. Adjustments										
4b. Repair/Replaced	1	1							1	3
4c. Total	1	1							1	3

4d. AN/APA-165 LRU Failures: 0

5. PARTS SUMMARY

5a. No. of MR's with Component Part Information Available 0.

5b. No. of MRA's Corrected by Adjustment Only 0.

5c. No. of Component Parts: Adjusted 0; Repaired/Replaced 0.

6. REMARKS

AIRCRAFT DATA SUMMARY

1. UNIT

1a. Tail Number 673 1b. Type of Fire Control APQ-109

2. DATA SOURCE

2a. Base Site Woodbridge, England 2b. Sqdn. No. 78

2c. Hrs. End Monitor 7848 2d. Date 11/23/70

2e. Hrs. Start Monitor 7180 2f. Date 10/26/70

2g. Total Monitor Hrs. 668

2h. ARINC Research Monitoring Personnel

M. J. Hutton

3. DATA SUMMARY

3a. Flights 11 3b. Flight Hrs. 17.9 3c. MRA's 2 3d. Maint. Manhours 24.0

3e. FC Downtime Hrs. 17.4 3f. Admin. Time Hrs. 9.4 3g. Repair Time Hrs. 8.0

4. LRU SUMMARY, APQ-109

Type of Action	Rcvr/ Xmtr	Sync	P.S.	Cont. Ind.	Ind. (RO)	Ind. (Pilot)	Ant.	Cont. Radar	Cont. Ant.	Total
4a. Adjustments		1		2						3
4b. Repair/Replaced										
4c. Total		1		2						3

4d. AN/APA-165 LRU Failures: 0

5. PARTS SUMMARY

5a. No. of MR's with Component Part Information Available 2.

5b. No. of MRA's Corrected by Adjustment Only 2.

5c. No. of Component Parts: Adjusted 4; Repaired/Replaced 0.

6. REMARKS: MRA #1 consisted of adjustment of A3723/R23 in ICU and adjustment of A2910/R7 in synchronizer.

MRA #2 consisted of adjustments to A3723/R1 and A3724/R1 in ICU.

AIRCRAFT DATA SUMMARY

1. UNIT

1a. Tail Number 681 1b. Type of Fire Control APQ-109

2. DATA SOURCE

2a. Base Site Woodbridge, England 2b. Sqdn. No. 78

2c. Hrs. End Monitor 7848 2d. Date 11/23/70

2e. Hrs. Start Monitor 7180 2f. Date 10/26/70

2g. Total Monitor Hrs. 668

2h. ARINC Research Monitoring Personnel

M. J. Hutton

3. DATA SUMMARY

3a. Flights 19 3b. Flight Hrs. 35.0 3c. MRA's 6 3d. Maint. Manhours 109.8

3e. FC Downtime Hrs. 68.7 3f. Admin. Time Hrs. 21.0 3g. Repair Time Hrs. 47.7

4. LRU SUMMARY, APQ-109

Type of Action	Rcvr/ Xmtr	Sync	P. S.	Cont. Ind.	Ind. (RO)	Ind. (Pilot)	Ant.	Cont. Radar	Cont. Ant.	Total
4a. Adjustments				1						1
4b. Repair/Replaced			2	1			1			4
4c. Total			2	2			1			5

4d. AN/APA-165 LRU Failures: 0

5. PARTS SUMMARY

5a. No. of MR's with Component Part Information Available 5.

5b. No. of MRA's Corrected by Adjustment Only 1.

5c. No. of Component Parts: Adjusted 2; Repaired/Replaced 6.

6. REMARKS

AIRCRAFT DATA SUMMARY

1. UNIT

1a. Tail Number 687 1b. Type of Fire Control APQ-109

2. DATA SOURCE

2a. Base Site Woodbridge, England 2b. Sqdn. No. 78

2c. Hrs. End Monitor 7848 2d. Date 11/23/70

2e. Hrs. Start Monitor 7180 2f. Date 10/26/70

2g. Total Monitor Hrs. 668

2h. ARINC Research Monitoring Personnel

M. J. Hutton

3. DATA SUMMARY

3a. Flights 1 3b. Flight Hrs. 1 3c. MRA's 1 3d. Maint. Manhours 4.5

3e. FC Downtime Hrs. 2.0 3f. Admin. Time Hrs. 0.5 3g. Repair Time Hrs. 1.5

4. LRU SUMMARY, APQ-109

Type of Action	Rcvr/ Xmtr	Sync	P. S.	Cont. Ind.	Ind. (RO)	Ind. (Pilot)	Ant.	Cont. Radar	Cont. Ant.	Total
4a. Adjustments										0
4b. Repair/Replaced										0
4c. Total										0

4d. AN/APA-165 LRU Failures: 0

5. PARTS SUMMARY

5a. No. of MR's with Component Part Information Available 0.

5b. No. of MRA's Corrected by Adjustment Only 0.

5c. No. of Component Parts: Adjusted 0; Repaired/Replaced 0.

6. REMARKS: No defect was found at A/C on 1 MR. Reported malfunction was: "Won't hold lock on in A/G."

AIRCRAFT DATA SUMMARY

1. UNIT

1a. Tail Number 692 1b. Type of Fire Control APQ-109

2. DATA SOURCE

2a. Base Site Woodbridge, England 2b. Sqdn. No. 78

2c. Hrs. End Monitor 7848 2d. Date 11/23/70

2e. Hrs. Start Monitor 7180 2f. Date 10/26/70

2g. Total Monitor Hrs. 668

2h. ARINC Research Monitoring Personnel
M. J. Hutton

3. DATA SUMMARY

3a. Flights 6 3b. Flight Hrs. 9.8 3c. MRA's 0 3d. Maint. Manhours ____

3e. FC Downtime Hrs. ____ 3f. Admin. Time Hrs. ____ 3g. Repair Time Hrs. ____

4. LRU SUMMARY, APQ-109

Type of Action	Rcvr/ Xmtr	Sync	P. S.	Cont. Ind.	Ind. (RO)	Ind. (Pilot)	Ant.	Cont. Radar	Cont. Ant.	Total
4a. Adjustments										0
4b. Repair/Replaced										0
4c. Total										0

4d. AN/APA-165 LRU Failures: 0

5. PARTS SUMMARY

5a. No. of MR's with Component Part Information Available 0.

5b. No. of MRA's Corrected by Adjustment Only 0.

5c. No. of Component Parts: Adjusted 0; Repaired/Replaced 0.

6. REMARKS

AIRCRAFT DATA SUMMARY

1. UNIT

1a. Tail Number 696 1b. Type of Fire Control APQ-109

2. DATA SOURCE

2a. Base Site Woodbridge, England 2b. Sqdn. No. 78

2c. Hrs. End Monitor 7848 2d. Date 11/23/70

2e. Hrs. Start Monitor 7180 2f. Date 10/26/70

2g. Total Monitor Hrs. 668

2h. ARINC Research Monitoring Personnel
M. J. Hutton

3. DATA SUMMARY

3a. Flights 16 3b. Flight Hrs. 25.2 3c. MRA's 3 3d. Maint. Manhours 49.2

3e. FC Downtime Hrs. 135.9 3f. Admin. Time Hrs. 119.5 3g. Repair Time Hrs. 16.4

4. LRU SUMMARY, APQ-109

Type of Action	Rcvr/ Xmtr	Sync	P.S.	Cont. Ind.	Ind. (RO)	Ind. (Pilot)	Ant.	Cont. Radar	Cont. Ant.	Total
4a. Adjustments										
4b. Repair/Replaced	1						1			2
4c. Total	1						1			2

4d. AN/APA-165 LRU Failures: 0

5. PARTS SUMMARY

5a. No. of MR's with Component Part Information Available 1.

5b. No. of MRA's Corrected by Adjustment Only 0.

5c. No. of Component Parts: Adjusted 0; Repaired/Replaced 4.

6. REMARKS: No defect found at A/C on 2 MR. Reported malfunctions were 1) "in-range" light stays on, and 2) no mag, no picture, all other voltages OK.

AIRCRAFT DATA SUMMARY

1. UNIT

1a. Tail Number 702 1b. Type of Fire Control APQ-109

2. DATA SOURCE

2a. Base Site Woodbridge, England 2b. Sqdn. No. 78

2c. Hrs. End Monitor 7848 2d. Date 11/23/70

2e. Hrs. Start Monitor 7180 2f. Date 10/26/70

2g. Total Monitor Hrs. 668

2h. ARINC Research Monitoring Personnel
M. J. Hutton

3. DATA SUMMARY

3a. Flights 10 3b. Flight Hrs. 21.1 3c. MRA's 2 3d. Maint. Manhours 28.5

3e. FC Downtime Hrs. 22.0 3f. Admin. Time Hrs. 12.5 3g. Repair Time Hrs. 9.5

4. LRU SUMMARY, APQ-109

Type of Action	Rcvr/ Xmtr	Sync	P.S.	Cont. Ind.	Ind. (RO)	Ind. (Pilot)	Ant.	Cont. Radar	Cont. Ant.	Total
4a. Adjustments										
4b. Repair/Replaced	1									1
4c. Total	1									1

4d. AN/APA-165 LRU Failures: 0

5. PARTS SUMMARY

5a. No. of MR's with Component Part Information Available 1.

5b. No. of MRA's Corrected by Adjustment Only 0.

5c. No. of Component Parts: Adjusted ____; Repaired/Replaced 3.

6. REMARKS: No defect found at A/C on 1 MR. Reported malfunction was: Radar would not PLMS and RA min gave incorrect reading.

C02-01-1-1094

AIRCRAFT DATA SUMMARY

1. UNIT

1a. Tail Number 708 1b. Type of Fire Control APQ-109

2. DATA SOURCE

2a. Base Site Seymour-Johnson 2b. Sqdn. No. 335

2c. Hrs. End Monitor 5496 2d. Date 8/17/70

2e. Hrs. Start Monitor 4632 2f. Date 7/12/70

2g. Total Monitor Hrs. 864

2h. ARINC Research Monitoring Personnel
M. Hutton, L. Larsen

3. DATA SUMMARY

3a. Flights 27 3b. Flight Hrs. 43 3c. MRA's 10 3d. Maint. Manhours 110.3

3e. FC Downtime Hrs. 66.9 3f. Admin. Time Hrs. 19.4 3g. Repair Time Hrs. 47.5

4. LRU SUMMARY, APQ-109

Type of Action	Rcvr/ Xmtr	Sync	P.S.	Cont. Ind.	Ind. (RO)	Ind. (Pilot)	Ant.	Cont. Radar	Cont. Ant.	Total
4a. Adjustments										
4b. Repair/Replaced	1	5	3	1						10
4c. Total	1	5	3	1						10

4d. AN/APA-165 LRU Failures: 1

5. PARTS SUMMARY

5a. No. of MR's with Component Part Information Available 4.

5b. No. of MRA's Corrected by Adjustment Only 0.

5c. No. of Component Parts: Adjusted 0; Repaired/Replaced 4.

6. REMARKS

AIRCRAFT DATA SUMMARY

1. UNIT

1a. Tail Number 710 1b. Type of Fire Control APQ-109

2. DATA SOURCE

2a. Base Site Woodbridge, England 2b. Sqdn. No. 78

2c. Hrs. End Monitor 7848 2d. Date 11/23/70

2e. Hrs. Start Monitor 7180 2f. Date 10/26/70

2g. Total Monitor Hrs. 668

2h. ARINC Research Monitoring Personnel
M. J. Hutton

3. DATA SUMMARY

3a. Flights 17 3b. Flight Hrs. 30.6 3c. MRA's 1 3d. Maint. Manhours 12.0

3e. FC Downtime Hrs. 4.2 3f. Admin. Time Hrs. 0.2 3g. Repair Time Hrs. 4.0

4. LRU SUMMARY, APQ-109

Type of Action	Rcvr/ Xmtr	Sync	P. S.	Cont. Ind.	Ind. (RO)	Ind. (Pilot)	Ant.	Cont. Radar	Cont. Ant.	Total
4a. Adjustments										
4b. Repair/Replaced	1									1
4c. Total	1									1

4d. AN/APA-165 LRU Failures: 0

5. PARTS SUMMARY

5a. No. of MR's with Component Part Information Available 1.

5b. No. of MRA's Corrected by Adjustment Only 0.

5c. No. of Component Parts: Adjusted 0; Repaired/Replaced 1.

6. REMARKS

AIRCRAFT DATA SUMMARY

1. UNIT

1a. Tail Number 711 1b. Type of Fire Control APQ-109

2. DATA SOURCE

2a. Base Site Woodbridge, England 2b. Sqdn. No. 78

2c. Hrs. End Monitor 7848 2d. Date 11/23/70

2e. Hrs. Start Monitor 7180 2f. Date 10/26/70

2g. Total Monitor Hrs. 668

2h. ARINC Research Monitoring Personnel

M. J. Hutton

3. DATA SUMMARY

3a. Flights 13 3b. Flight Hrs. 22.9 3c. MRA's 3 3d. Maint. Manhours 25.3

3e. FC Downtime Hrs. 18.9 3f. Admin. Time Hrs. 7.3 3g. Repair Time Hrs. 11.6

4. LRU SUMMARY, APQ-109

Type of Action	Rcvr/ Xmtr	Sync	P.S.	Cont. Ind.	Ind. (RO)	Ind. (Pilot)	Ant.	Cont. Radar	Cont. Ant.	Total
4a. Adjustments				2						2
4b. Repair/Replaced				1						1
4c. Total				3						3

4d. AN/APA-165 LRU Failures: 0

5. PARTS SUMMARY

5a. No. of MR's with Component Part Information Available 2.

5b. No. of MRA's Corrected by Adjustment Only 2.

5c. No. of Component Parts: Adjusted 3; Repaired/Replaced 0.

6. REMARKS

AIRCRAFT DATA SUMMARY

1. UNIT

1a. Tail Number 712 1b. Type of Fire Control APQ-109

2. DATA SOURCE

2a. Base Site Woodbridge, England 2b. Sqdn. No. 78

2c. Hrs. End Monitor 7848 2d. Date 11/23/70

2e. Hrs. Start Monitor 7180 2f. Date 10/26/70

2g. Total Monitor Hrs. 668

2h. ARINC Research Monitoring Personnel

M. J. Hutton

3. DATA SUMMARY

3a. Flights 7 3b. Flight Hrs. 7.8 3c. MRA's 1 3d. Maint. Manhours 15.0

3e. FC Downtime Hrs. 10.0 3f. Admin. Time Hrs. 6.0 3g. Repair Time Hrs. 4.0

4. LRU SUMMARY, APQ-109

Type of Action	Rcvr/ Xmtr	Sync	P. S.	Cont. Ind.	Ind. (RO)	Ind. (Pilot)	Ant.	Cont. Radar	Cont. Ant.	Total
4a. Adjustments			1							1
4b. Repair/Replaced										
4c. Total			1							1

4d. AN/APA-165 LRU Failures: 0

5. PARTS SUMMARY

5a. No. of MR's with Component Part Information Available 1.

5b. No. of MRA's Corrected by Adjustment Only 1.

5c. No. of Component Parts: Adjusted 1; Repaired/Replaced 0.

6. REMARKS: Only maintenance action was adjustment of R4821.

AIRCRAFT DATA SUMMARY

1. UNIT

1a. Tail Number 721 1b. Type of Fire Control APQ-109

2. DATA SOURCE

2a. Base Site Woodbridge, England 2b. Sqdn. No. 78

2c. Hrs. End Monitor 7848 2d. Date 11/23/70

2e. Hrs. Start Monitor 7180 2f. Date 10/26/70

2g. Total Monitor Hrs. 668

2h. ARINC Research Monitoring Personnel
M. J. Hutton

3. DATA SUMMARY

3a. Flights 2 3b. Flight Hrs. 3.1 3c. MRA's 1 3d. Maint. Manhours 6.0

3e. FC Downtime Hrs. 3.2 3f. Admin. Time Hrs. 1.2 3g. Repair Time Hrs. 2.0

4. LRU SUMMARY, APQ-109

Type of Action	Rcvr/ Xmtr	Sync	P.S.	Cont. Ind.	Ind. (RO)	Ind. (Pilot)	Ant.	Cont. Radar	Cont. Ant.	Total
4a. Adjustments				1						1
4b. Repair/Replaced										
4c. Total				1						1

4d. AN/APA-165 LRU Failures: 0

5. PARTS SUMMARY

5a. No. of MR's with Component Part Information Available 1.

5b. No. of MRA's Corrected by Adjustment Only 1.

5c. No. of Component Parts: Adjusted 1; Repaired/Replaced 0.

6. REMARKS: Only maintenance action was adjustment of R0008 in ICU.

AIRCRAFT DATA SUMMARY

1. UNIT

1a. Tail Number 731 1b. Type of Fire Control APQ-109

2. DATA SOURCE

2a. Base Site Woodbridge, England 2b. Sqdn. No. 78

2c. Hrs. End Monitor 7848 2d. Date 11/23/70

2e. Hrs. Start Monitor 7180 2f. Date 10/26/70

2g. Total Monitor Hrs. 668

2h. ARINC Research Monitoring Personnel
M.J. Hutton

3. DATA SUMMARY

3a. Flights 17 3b. Flight Hrs. 26.7 3c. MRA's 1 3d. Maint. Manhours 12.3

3e. FC Downtime Hrs. 8.5 3f. Admin. Time Hrs. 4.4 3g. Repair Time Hrs. 4.1

4. LRU SUMMARY, APQ-109

Type of Action	Rcvr/ Xmtr	Sync	P.S.	Cont. Ind.	Ind. (RO)	Ind. (Pilot)	Ant.	Cont. Radar	Cont. Ant.	Total
4a. Adjustments	1									1
4b. Repair/Replaced										
4c. Total	1									1

4d. AN/APA-165 LRU Failures: 0

5. PARTS SUMMARY

5a. No. of MR's with Component Part Information Available 1.

5b. No. of MRA's Corrected by Adjustment Only 1.

5c. No. of Component Parts: Adjusted 1; Repaired/Replaced 0.

6. REMARKS: Only maintenance action was adjustment of R1412 in Rcvr/Xmtr unit.

AIRCRAFT DATA SUMMARY

1. UNIT

1a. Tail Number 735 1b. Type of Fire Control APQ-107

2. DATA SOURCE

2a. Base Site Woodbridge, England 2b. Sqdn. No. 78

2c. Hrs. End Monitor 7848 2d. Date 11/23/70

2e. Hrs. Start Monitor 7180 2f. Date 10/26/70

2g. Total Monitor Hrs. 668

2h. ARINC Research Monitoring Personnel
M. J. Hutton

3. DATA SUMMARY

3a. Flights 13 3b. Flight Hrs. 22.4 3c. MRA's 6 3d. Maint. Manhours 145.3

3e. FC Downtime Hrs. 93.6 3f. Admin. Time Hrs. 19.4 3g. Repair Time Hrs. 74.2

4. LRU SUMMARY, APQ-109

Type of Action	Rcvr/ Xmtr	Sync	P.S.	Cont. Ind.	Ind. (RO)	Ind. (Pilot)	Ant.	Cont. Radar	Cont. Ant.	Total
4a. Adjustments		1								1
4b. Repair/Replaced	1		1	2			1			5
4c. Total	1	1	1	2			1			6

4d. AN/APA-165 LRU Failures: 0

5. PARTS SUMMARY

5a. No. of MR's with Component Part Information Available 5.

5b. No. of MRA's Corrected by Adjustment Only 1.

5c. No. of Component Parts: Adjusted 4; Repaired/Replaced 8.

6. REMARKS

AIRCRAFT DATA SUMMARY

1. UNIT

1a. Tail Number 736 1b. Type of Fire Control APQ-109

2. DATA SOURCE

2a. Base Site Woodbridge, England 2b. Sqdn. No. 78

2c. Hrs. End Monitor 7848 2d. Date 11/23/70

2e. Hrs. Start Monitor 7180 2f. Date 10/26/70

2g. Total Monitor Hrs. 668

2h. ARINC Research Monitoring Personnel
M. J. Hutton

3. DATA SUMMARY

3a. Flights 1 3b. Flight Hrs. 0.8 3c. MRA's 0 3d. Maint. Manhours ____

3e. FC Downtime Hrs. ____ 3f. Admin. Time Hrs. ____ 3g. Repair Time Hrs. 0

4. LRU SUMMARY, APQ-109

Type of Action	Rcvr/ Xmtr	Sync	P. S.	Cont. Ind.	Ind. (RO)	Ind. (Pilot)	Ant.	Cont. Radar	Cont. Ant.	Total
4a. Adjustments										0
4b. Repair/Replaced										0
4c. Total										0

4d. AN/APA-165 LRU Failures: 0

5. PARTS SUMMARY

5a. No. of MR's with Component Part Information Available 0.

5b. No. of MRA's Corrected by Adjustment Only 0.

5c. No. of Component Parts: Adjusted 0; Repaired/Replaced 0.

6. REMARKS

AIRCRAFT DATA SUMMARY

1. UNIT

1a. Tail Number 738 1b. Type of Fire Control APQ-109

2. DATA SOURCE

2a. Base Site Woodbridge, England 2b. Sqdn. No. 78

2c. Hrs. End Monitor 7848 2d. Date 11/23/70

2e. Hrs. Start Monitor 7180 2f. Date 10/26/70

2g. Total Monitor Hrs. 668

2h. ARINC Research Monitoring Personnel
M. J. Hutton

3. DATA SUMMARY

3a. Flights 4 3b. Flight Hrs. 7.7 3c. MRA's 2 3d. Maint. Manhours 25.8

3e. FC Downtime Hrs. 83.6 3f. Admin. Time Hrs. 79.3 3g. Repair Time Hrs. 4.3

4. LRU SUMMARY, APQ-109

Type of Action	Rcvr/ Xmtr	Sync	P. S.	Cont. Ind.	Ind. (RO)	Ind. (Pilot)	Ant.	Cont. Radar	Cont. Ant.	Total
4a. Adjustments										
4b. Repair/Replaced	1			1						2
4c. Total	1			1						2

4d. AN/APA-165 LRU Failures: 0

5. PARTS SUMMARY

5a. No. of MR's with Component Part Information Available 1.

5b. No. of MRA's Corrected by Adjustment Only 0.

5c. No. of Component Parts: Adjusted 0; Repaired/Replaced 2.

6. REMARKS: MRA #1 - Replaced fuses F-0402 and F-0403 in Rcvr/Xmetr.
MRA #2 - Drained water out of A3708 in ICU. Bench checked good.

AIRCRAFT DATA SUMMARY

1. UNIT

1a. Tail Number 739 1b. Type of Fire Control APQ-19

2. DATA SOURCE

2a. Base Site Woodbridge, England 2b. Sqdn. No. 78

2c. Hrs. End Monitor 7848 2d. Date 11/23/70

2e. Hrs. Start Monitor 7180 2f. Date 10/26/70

2g. Total Monitor Hrs. 668

2h. ARINC Research Monitoring Personnel
M.J. Hutton

3. DATA SUMMARY

3a. Flights 26 3b. Flight Hrs. 51.7 3c. MRA's 8 3d. Maint. Manhours 119.9

3e. FC Downtime Hrs. 62.3 3f. Admin. Time Hrs. 22.0 3g. Repair Time Hrs. 40.3

4. LRU SUMMARY, APQ-109

Type of Action	Rcvr/ Xmtr	Sync	P.S.	Cont. Ind.	Ind. (RO)	Ind. (Pilot)	Ant.	Cont. Radar	Cont. Ant.	Total
4a. Adjustments	1	1	1		1	1				5
4b. Repair/Replaced	1	1		1				1		4
4c. Total	2	2	1	1	1	1		1		9

4d. AN/APA-165 LRU Failures: 0

5. PARTS SUMMARY

5a. No. of MR's with Component Part Information Available 2.

5b. No. of MRA's Corrected by Adjustment Only 1.

5c. No. of Component Parts: Adjusted 4; Repaired/Replaced 1.

6. REMARKS: No defect found at A/C on 3MR's. Reported malfunctions were 1) radar inoperate, lost MAG; 2) radar breakds lock at short ranges; 3) top half of scope fuzzy.

AIRCRAFT DATA SUMMARY

1. UNIT

1a. Tail Number 748 1b. Type of Fire Control APQ-109

2. DATA SOURCE

2a. Base Site Woodbridge, England 2b. Sqdn. No. 78

2c. Hrs. End Monitor 7848 2d. Date 11/23/70

2e. Hrs. Start Monitor 7180 2f. Date 10/26/70

2g. Total Monitor Hrs. 668

2h. ARINC Research Monitoring Personnel
M. J. Hutton

3. DATA SUMMARY

3a. Flights 12 3b. Flight Hrs. 22.2 3c. MRA's 2 3d. Maint. Manhours 21.6

3e. FC Downtime Hrs. 8.5 3f. Admin. Time Hrs. 0.1 3g. Repair Time Hrs. 8.4

4. LRU SUMMARY, APQ-109

Type of Action	Rcvr/ Xmtr	Sync	P.S.	Cont. Ind.	Ind. (RO)	Ind. (Pilot)	Ant.	Cont. Radar	Cont. Ant.	Total
4a. Adjustments										
4b. Repair/Replaced							2			2
4c. Total							2			2

4d. AN/APA-165 LRU Failures: 0

5. PARTS SUMMARY

5a. No. of MR's with Component Part Information Available 0.

5b. No. of MRA's Corrected by Adjustment Only 0.

5c. No. of Component Parts: Adjusted 0; Repaired/Replaced 0.

6. REMARKS:

AIRCRAFT DATA SUMMARY

1. UNIT

1a. Tail Number 749 1b. Type of Fire Control APQ-109

2. DATA SOURCE

2a. Base Site Woodbridge, England 2b. Sqdn. No. 78

2c. Hrs. End Monitor 7848 2d. Date 11/23/70

2e. Hrs. Start Monitor 7180 2f. Date 10/26/70

2g. Total Monitor Hrs. 668

2h. ARINC Research Monitoring Personnel
M. J. Hutton

3. DATA SUMMARY

3a. Flights 12 3b. Flight Hrs. 22.3 3c. MRA's 2 3d. Maint. Manhours 63.3

3e. FC Downtime Hrs. 33.9 3f. Admin. Time Hrs. 5.8 3g. Repair Time Hrs. 28.1

4. LRU SUMMARY, APQ-109

Type of Action	Rcvr/ Xmtr	Sync	P. S.	Cont. Ind.	Ind. (RO)	Ind. (Pilot)	Ant.	Cont. Radar	Cont. Ant.	Total
4a. Adjustments										
4b. Repair/Replaced	1	1								2
4c. Total	1	1								2

4d. AN/APA-165 LRU Failures: 0

5. PARTS SUMMARY

5a. No. of MR's with Component Part Information Available 2.

5b. No. of MRA's Corrected by Adjustment Only 0.

5c. No. of Component Parts: Adjusted 0; Repaired/Replaced 3.

6. REMARKS: MRA #1 - bad acquisition symbols. Y2202 bad.
MRA #2 - replaced waveguide switch and mag cap (C401)

AIRCRAFT DATA SUMMARY

1. UNIT

1a. Tail Number 756 1b. Type of Fire Control APQ-109

2. DATA SOURCE

2a. Base Site Woodbridge, England 2b. Sqdn. No. 78

2c. Hrs. End Monitor 7848 2d. Date 11/23/70

2e. Hrs. Start Monitor 7180 2f. Date 10/26/70

2g. Total Monitor Hrs. 668

2h. ARINC Research Monitoring Personnel

M. J. Hutton

3. DATA SUMMARY

3a. Flights 18 3b. Flight Hrs. 37.5 3c. MRA's 7 3d. Maint. Manhours 91.1

3e. FC Downtime Hrs. 170.4 3f. Admin. Time Hrs. 135.7 3g. Repair Time Hrs. 34.7

4. LRU SUMMARY, APQ-109

Type of Action	Rcvr/ Xmtr	Sync	P. S.	Cont. Ind.	Ind. (RO)	Ind. (Pilot)	Ant.	Cont. Radar	Cont. Ant.	Total
4a. Adjustments										
4b. Repair/Replaced	1						1			2
4c. Total	1						1			2

4d. AN/APA-165 LRU Failures: 0

5. PARTS SUMMARY

5a. No. of MR's with Component Part Information Available 1.

5b. No. of MRA's Corrected by Adjustment Only 1.

5c. No. of Component Parts: Adjusted 1; Repaired/Replaced _____.

6. REMARKS: No defect found at A/C on 5 MR's. Reported malfunctions were 1) B-sweep oscillates in bits 1 & 3; 2) Bit 6 range gate drives out; 3) Lost ring. Voltage & crystals ok; 4) No lock-on in bits 5 A/G; 5) Lost MAG. at low altitude.

AIRCRAFT DATA SUMMARY

1. UNIT

1a. Tail Number 759 1b. Type of Fire Control APQ-109

2. DATA SOURCE

2a. Base Site Woodbridge, England 2b. Sqdn. No. 78

2c. Hrs. End Monitor 7848 2d. Date 11/23/70

2e. Hrs. Start Monitor 7180 2f. Date 10/26/70

2g. Total Monitor Hrs. 668

2h. ARINC Research Monitoring Personnel
M. J. Hutton

3. DATA SUMMARY

3a. Flights 13 3b. Flight Hrs. 22.8 3c. MRA's 1 3d. Maint. Manhours 24.0

3e. FC Downtime Hrs. 9.0 3f. Admin. Time Hrs. 1.0 3g. Repair Time Hrs. 8.0

4. LRU SUMMARY, APQ-109

Type of Action	Rcvr/ Xmtr	Sync	P.S.	Cont. Ind.	Ind. (RO)	Ind. (Pilot)	Ant.	Cont. Radar	Cont. Ant.	Total
4a. Adjustments		1								1
4b. Repair/Replaced										
4c. Total		1								1

4d. AN/APA-165 LRU Failures: 0

5. PARTS SUMMARY

5a. No. of MR's with Component Part Information Available 0.

5b. No. of MRA's Corrected by Adjustment Only 0.

5c. No. of Component Parts: Adjusted 0; Repaired/Replaced _____.

6. REMARKS: Aligned synchronizer. Specific adjustments not indicated.

AIRCRAFT DATA SUMMARY

1. UNIT

1a. Tail Number 767 1b. Type of Fire Control APQ-109

2. DATA SOURCE

2a. Base Site Woodbridge, England 2b. Sqdn. No. 78

2c. Hrs. End Monitor 7848 2d. Date 11/23/70

2e. Hrs. Start Monitor 7180 2f. Date 10/26/70

2g. Total Monitor Hrs. 668

2h. ARINC Research Monitoring Personnel
M. J. Hutton

3. DATA SUMMARY

3a. Flights 6 3b. Flight Hrs. 13.2 3c. MRA's 1 3d. Maint. Manhours 16.8

3e. FC Downtime Hrs. 57.3 3f. Admin. Time Hrs. 51.7 3g. Repair Time Hrs. 5.6

4. LRU SUMMARY, APQ-109

Type of Action	Rcvr/ Xmtr	Sync	P. S.	Cont. Ind.	Ind. (RO)	Ind. (Pilot)	Ant.	Cont. Radar	Cont. Ant.	Total
4a. Adjustments										
4b. Repair/Replaced		1								1
4c. Total		1								1

4d. AN/APA-165 LRU Failures: 0

5. PARTS SUMMARY

5a. No. of MR's with Component Part Information Available 1.

5b. No. of MRA's Corrected by Adjustment Only 0.

5c. No. of Component Parts: Adjusted 0; Repaired/Replaced 1.

6. REMARKS: MRA involved repair of Y2201.

AIRCRAFT DATA SUMMARY

1. UNIT

1a. Tail Number 776 1b. Type of Fire Control APQ-109

2. DATA SOURCE

2a. Base Site Woodbridge, England 2b. Sqdn. No. 78

2c. Hrs. End Monitor 7848 2d. Date 11/23/70

2e. Hrs. Start Monitor 7180 2f. Date 10/26/70

2g. Total Monitor Hrs. 668

2h. ARINC Research Monitoring Personnel
M. J. Hutton

3. DATA SUMMARY

3a. Flights 24 3b. Flight Hrs. 39.0 3c. MRA's 5 3d. Maint. Manhours 81.4

3e. FC Downtime Hrs. 231.3 3f. Admin. Time Hrs. 198.3 3g. Repair Time Hrs. 33.0

4. LRU SUMMARY, APQ-109

Type of Action	Rcvr/ Xmtr	Sync	P. S.	Cont. Ind.	Ind. (RO)	Ind. (Pilot)	Ant.	Cont. Radar	Cont. Ant.	Total
4a. Adjustments	1	1	1							3
4b. Repair/Replaced	2						1			3
4c. Total	3	1	1				1			6

4d. AN/APA-165 LRU Failures: 1

5. PARTS SUMMARY

5a. No. of MR's with Component Part Information Available 2.

5b. No. of MRA's Corrected by Adjustment Only 1.

5c. No. of Component Parts: Adjusted 1; Repaired/Replaced 1.

6. REMARKS: No defect found at A/C on 1 MR. Reported malfunction was: "Lost video on real scope after one hour".

AIRCRAFT DATA SUMMARY

1. UNIT

1a. Tail Number 777 1b. Type of Fire Control APQ-109

2. DATA SOURCE

2a. Base Site Seymour-Johnson 2b. Sqdn. No. 335

2c. Hrs. End Monitor 6840 2d. Date 10/12/70

2e. Hrs. Start Monitor 4632 2f. Date 7/12/70

2g. Total Monitor Hrs. 2208

2h. ARINC Research Monitoring Personnel
M. Hutton, L. Larsen

3. DATA SUMMARY

3a. Flights 55 3b. Flight Hrs. 117.6 3c. MRA's 10 3d. Maint. Manhours 46.4

3e. FC Downtime Hrs. 73.7 3f. Admin. Time Hrs. 53.1 3g. Repair Time Hrs. 20.6

4. LRU SUMMARY, APQ-109

Type of Action	Rcvr/ Xmtr	Sync	P.S.	Cont. Ind.	Ind. (RO)	Ind. (Pilot)	Ant.	Cont. Radar	Cont. Ant.	Total
4a. Adjustments									1	1
4b. Repair/Replaced	2	2	1	1		1				7
4c. Total	2	2	1	1		1			1	8

4d. AN/APA-165 LRU Failures: 1

5. PARTS SUMMARY

5a. No. of MR's with Component Part Information Available 3.

5b. No. of MRA's Corrected by Adjustment Only 1.

5c. No. of Component Parts: Adjusted 1; Repaired/Replaced 3.

6. REMARKS

AIRCRAFT DATA SUMMARY

1. UNIT

1a. Tail Number 788 1b. Type of Fire Control APQ-109

2. DATA SOURCE

2a. Base Site Woodbridge, England 2b. Sqdn. No. 78

2c. Hrs. End Monitor 7848 2d. Date 11/23/70

2e. Hrs. Start Monitor 7180 2f. Date 10/26/70

2g. Total Monitor Hrs. 668

2h. ARINC Research Monitoring Personnel
M. J. Hutton

3. DATA SUMMARY

3a. Flights 3 3b. Flight Hrs. 4.7 3c. MRA's 0 3d. Maint. Manhours ____

3e. FC Downtime Hrs. ____ 3f. Admin. Time Hrs. ____ 3g. Repair Time Hrs. ____

4. LRU SUMMARY, APQ-109

Type of Action	Rcvr/ Xmtr	Sync	P. S.	Cont. Ind.	Ind. (RO)	Ind. (Pilot)	Ant.	Cont. Radar	Cont. Ant.	Total
4a. Adjustments										
4b. Repair/Replaced										
4c. Total										

4d. AN/APA-165 LRU Failures: 0

5. PARTS SUMMARY

5a. No. of MR's with Component Part Information Available 0.

5b. No. of MRA's Corrected by Adjustment Only 0.

5c. No. of Component Parts: Adjusted 0; Repaired/Replaced 0.

6. REMARKS

AIRCRAFT DATA SUMMARY

1. UNIT

1a. Tail Number 956 1b. Type of Fire Control APQ-109

2. DATA SOURCE

2a. Base Site Seymour-Johnson 2b. Sqdn. No. 335

2c. Hrs. End Monitor 6840 2d. Date 10/12/70

2e. Hrs. Start Monitor 4632 2f. Date 7/12/70

2g. Total Monitor Hrs. 2208

2h. ARINC Research Monitoring Personnel
M. Hutton, L. Larsen

3. DATA SUMMARY

3a. Flights 55 3b. Flight Hrs. 103.4 3c. MRA's 19 3d. Maint. Manhours 89.3

3e. FC Downtime Hrs. 101.3 3f. Admin. Time Hrs. 62.4 3g. Repair Time Hrs. 38.9

4. LRU SUMMARY, APQ-109

Type of Action	Rcvr/ Xmtr	Sync	P.S.	Cont. Ind.	Ind. (RO)	Ind. (Pilot)	Ant.	Cont. Radar	Cont. Ant.	Total
4a. Adjustments		2	1	9		1				13
4b. Repair/Replaced	4					2				6
4c. Total	4	2	1	9		3				19

4d. AN/APA-165 LRU Failures: 1

5. PARTS SUMMARY

5a. No. of MR's with Component Part Information Available 13.

5b. No. of MRA's Corrected by Adjustment Only 10.

5c. No. of Component Parts: Adjusted 27; Repaired/Replaced 3.

6. REMARKS

AIRCRAFT DATA SUMMARY

1. UNIT

1a. Tail Number 7456 1b. Type of Fire Control APQ-109

2. DATA SOURCE

2a. Base Site Seymour-Johnson 2b. Sqdn. No. 335

2c. Hrs. End Monitor 6792 2d. Date 10/10/70

2e. Hrs. Start Monitor 4872 2f. Date 7/22/70

2g. Total Monitor Hrs. 1920

2h. ARINC Research Monitoring Personnel
M. Hutton, L. Larsen

3. DATA SUMMARY

3a. Flights 60 3b. Flight Hrs. 100.8 3c. MRA's 15 3d. Maint. Manhours 75.4

3e. FC Downtime Hrs. 88.4 3f. Admin. Time Hrs. 51.6 3g. Repair Time Hrs. 36.8

4. LRU SUMMARY, APQ-109

Type of Action	Rcvr/ Xmtr	Sync	P.S.	Cont. Ind.	Ind. (RO)	Ind. (Pilot)	Ant.	Cont. Radar	Cont. Ant.	Total
4a. Adjustments	1		1	4	1					7
4b. Repair/Replaced	1		2	2			1		1	7
4c. Total	2		3	6	1		1		1	14

4d. AN/APA-165 LRU Failures: 0

5. PARTS SUMMARY

5a. No. of MR's with Component Part Information Available 7.

5b. No. of MRA's Corrected by Adjustment Only 5.

5c. No. of Component Parts: Adjusted 10; Repaired/Replaced 2.

6. REMARKS

AIRCRAFT DATA SUMMARY

1. UNIT

1a. Tail Number 7469 1b. Type of Fire Control APQ-109

2. DATA SOURCE

2a. Base Site Seymour-Johnson 2b. Sqdn. No. 335

2c. Hrs. End Monitor 6840 2d. Date 10/12/70

2e. Hrs. Start Monitor 4632 2f. Date 7/12/70

2g. Total Monitor Hrs. 2208

2h. ARINC Research Monitoring Personnel
M. Hutton, L. Larsen

3. DATA SUMMARY

3a. Flights 49 3b. Flight Hrs. 80.7 3c. MRA's 16 3d. Maint. Manhours 88.9

3e. FC Downtime Hrs. 80.1 3f. Admin. Time Hrs. 37.9 3g. Repair Time Hrs. 42.2

4. LRU SUMMARY, APQ-109

Type of Action	Rcvr/ Xmtr	Sync	P.S.	Cont. Ind.	Ind. (RO)	Ind. (Pilot)	Ant.	Cont. Radar	Cont. Ant.	Total
4a. Adjustments		1		5						6
4b. Repair/Replaced		2	2		1		1		3	9
4c. Total		3	2	5	1		1		3	15

4d. AN/APA-165 LRU Failures: 0

5. PARTS SUMMARY

5a. No. of MR's with Component Part Information Available 5.

5b. No. of MRA's Corrected by Adjustment Only 5.

5c. No. of Component Parts: Adjusted 10; Repaired/Replaced 0.

6. REMARKS

AIRCRAFT DATA SUMMARY

1. UNIT

1a. Tail Number 7478 1b. Type of Fire Control APQ-109

2. DATA SOURCE

2a. Base Site Seymour-Johnson 2b. Sqdn. No. 335

2c. Hrs. End Monitor 6648 2d. Date 10/4/70

2e. Hrs. Start Monitor 4632 2f. Date 7/12/70

2g. Total Monitor Hrs. 2016

2h. ARINC Research Monitoring Personnel
M. Hutton, L. Larsen

3. DATA SUMMARY

3a. Flights 58 3b. Flight Hrs. 112.2 3c. MRA's 19 3d. Maint. Manhours 90.3

3e. FC Downtime Hrs. 110.4 3f. Admin. Time Hrs. 67.6 3g. Repair Time Hrs. 42.8

4. LRU SUMMARY, APQ-109

Type of Action	Rcvr/ Xmtr	Sync	P.S.	Cont. Ind.	Ind. (RO)	Ind. (Pilot)	Ant.	Cont. Radar	Cont. Ant.	Total
4a. Adjustments	1	1		10						12
4b. Repair/Replaced	2	2	3	2	1		1			11
4c. Total	3	3	3	12	1		1			23

4d. AN/APA-165 LRU Failures: 0

5. PARTS SUMMARY

5a. No. of MR's with Component Part Information Available 13.

5b. No. of MRA's Corrected by Adjustment Only 8.

5c. No. of Component Parts: Adjusted 35; Repaired/Replaced 5.

6. REMARKS

AIRCRAFT DATA SUMMARY

1. UNIT

1a. Tail Number 7487 1b. Type of Fire Control APQ-109

2. DATA SOURCE

2a. Base Site Seymour-Johnson 2b. Sqdn. No. 335

2c. Hrs. End Monitor 6840 2d. Date 10/12/70

2e. Hrs. Start Monitor 4680 2f. Date 7/14/70

2g. Total Monitor Hrs. 2160

2h. ARINC Research Monitoring Personnel
M. Hutton, L. Larsen

3. DATA SUMMARY

3a. Flights 71 3b. Flight Hrs. 121.4 3c. MRA's 26 3d. Maint. Manhours 134.6

3e. FC Downtime Hrs. 131 3f. Admin. Time Hrs. 70.1 3g. Repair Time Hrs. 60.9

4. LRU SUMMARY, APQ-109

Type of Action	Rcvr/ Xmtr	Sync	P. S.	Cont. Ind.	Ind. (RO)	Ind. (Pilot)	Ant.	Cont. Radar	Cont. Ant.	Total
4a. Adjustments		2		6						8
4b. Repair/Replaced	2		6	4			2			14
4c. Total	2	2	6	10			2			22

4d. AN/APA-165 LRU Failures: 1

5. PARTS SUMMARY

5a. No. of MR's with Component Part Information Available 12.

5b. No. of MRA's Corrected by Adjustment Only 6.

5c. No. of Component Parts: Adjusted 25; Repaired/Replaced 8.

6. REMARKS

AIRCRAFT DATA SUMMARY

1. UNIT

1a. Tail Number 7489 1b. Type of Fire Control APQ-109

2. DATA SOURCE

2a. Base Site Seymour-Johnson 2b. Sqdn. No. 335

2c. Hrs. End Monitor 6840 2d. Date 10/12/70

2e. Hrs. Start Monitor 4632 2f. Date 7/12/70

2g. Total Monitor Hrs. 2208

2h. ARINC Research Monitoring Personnel
M. Hutton, L. Larsen

3. DATA SUMMARY

3a. Flights 66 3b. Flight Hrs. 105.2 3c. MRA's 18 3d. Maint. Manhours 114.6

3e. FC Downtime Hrs. 106 3f. Admin. Time Hrs. 59.2 3g. Repair Time Hrs. 46.8

4. LRU SUMMARY, APQ-109

Type of Action	Rcvr/ Xmtr	Sync	P.S.	Cont. Ind.	Ind. (RO)	Ind. (Pilot)	Ant.	Cont. Radar	Cont. Ant.	Total
4a. Adjustments	3			1	2				1	7
4b. Repair/Replaced	4	2	3		2		1		1	13
4c. Total	7	2	3	1	4		1		2	20

4d. AN/APA-165 LRU Failures: 0

5. PARTS SUMMARY

5a. No. of MR's with Component Part Information Available 10.

5b. No. of MRA's Corrected by Adjustment Only 5.

5c. No. of Component Parts: Adjusted 9; Repaired/Replaced 5.

6. REMARKS

AIRCRAFT DATA SUMMARY

1. UNIT

1a. Tail Number 7490 1b. Type of Fire Control APQ-109

2. DATA SOURCE

2a. Base Site Seymour-Johnson 2b. Sqdn. No. 335

2c. Hrs. End Monitor 6840 2d. Date 10/12/70

2e. Hrs. Start Monitor 4800 2f. Date 7/19/70

2g. Total Monitor Hrs. 2040

2h. ARINC Research Monitoring Personnel
M. Hutton, L. Larsen

3. DATA SUMMARY

3a. Flights 52 3b. Flight Hrs. 73.5 3c. MRA's 21 3d. Maint. Manhours 146.8

3e. FC Downtime Hrs. 95 3f. Admin. Time Hrs. 37.4 3g. Repair Time Hrs. 57.6

4. LRU SUMMARY, APQ-109

Type of Action	Rcvr/ Xmtr	Sync	P. S.	Cont. Ind.	Ind. (RO)	Ind. (Pilot)	Ant.	Cont. Radar	Cont. Ant.	Total
4a. Adjustments		1	1	8	1					11
4b. Repair/Replaced	3	2	1		3	1	1	1		12
4c. Total	3	3	2	8	4	1	1	1		23

4d. AN/APA-165 LRU Failures: 2

5. PARTS SUMMARY

5a. No. of MR's with Component Part Information Available 11.

5b. No. of MRA's Corrected by Adjustment Only 9.

5c. No. of Component Parts: Adjusted 35; Repaired/Replaced 7.

6. REMARKS: No defects found on A/C level on 1 MR. Reported malfunction was: "Radar will not lock-on".

AIRCRAFT DATA SUMMARY

1. UNIT

1a. Tail Number 7491 1b. Type of Fire Control APQ-109

2. DATA SOURCE

2a. Base Site Seymour-Johnson 2b. Sqdn. No. 335

2c. Hrs. End Monitor 5544 2d. Date 8/19/70

2e. Hrs. Start Monitor 4632 2f. Date 7/12/70

2g. Total Monitor Hrs. 912

2h. ARINC Research Monitoring Personnel
M. Hutton, L. Larsen

3. DATA SUMMARY

3a. Flights 32 3b. Flight Hrs. 45.6 3c. MRA's 2 3d. Maint. Manhours 4

3e. FC Downtime Hrs. 14 3f. Admin. Time Hrs. 12 3g. Repair Time Hrs. 2

4. LRU SUMMARY, APQ-109

Type of Action	Rcvr/ Xmtr	Sync	P.S.	Cont. Ind.	Ind. (RO)	Ind. (Pilot)	Ant.	Cont. Radar	Cont. Ant.	Total
4a. Adjustments				1						1
4b. Repair/Replaced										
4c. Total				1						1

4d. AN/APA-165 LRU Failures: 0

5. PARTS SUMMARY

5a. No. of MR's with Component Part Information Available 1.

5b. No. of MRA's Corrected by Adjustment Only 1.

5c. No. of Component Parts: Adjusted 1; Repaired/Replaced 0.

6. REMARKS: No defect found at A/C level on 1 MR. Reported malfunction was: "Radar XTAL #1 was out."

AIRCRAFT DATA SUMMARY

1. UNIT

1a. Tail Number 7500 1b. Type of Fire Control APQ-109

2. DATA SOURCE

2a. Base Site Seymour-Johnson 2b. Sqdn. No. 335

2c. Hrs. End Monitor 6840 2d. Date 10/12/70

2e. Hrs. Start Monitor 4632 2f. Date 7/12/70

2g. Total Monitor Hrs. 2208

2h. ARINC Research Monitoring Personnel
M. Hutton, L. Larsen

3. DATA SUMMARY

3a. Flights 53 3b. Flight Hrs. 83.2 3c. MRA's 12 3d. Maint. Manhours 45.6

3e. FC Downtime Hrs. 44.3 3f. Admin. Time Hrs. 26.8 3g. Repair Time Hrs. 17.5

4. LRU SUMMARY, APQ-109

Type of Action	Rcvr/ Xmtr	Sync	P.S.	Cont. Ind.	Ind. (RO)	Ind. (Pilot)	Ant.	Cont. Radar	Cont. Ant.	Total
4a. Adjustments				3	1					4
4b. Repair/Replaced	2	1		1		1				5
4c. Total	2	1		4	1	1				9

4d. AN/APA-165 LRU Failures: 1

5. PARTS SUMMARY

5a. No. of MR's with Component Part Information Available 5.

5b. No. of MRA's Corrected by Adjustment Only 4.

5c. No. of Component Parts: Adjusted 9; Repaired/Replaced 1.

6. REMARKS: No defect found at A/C level on 1 MR. Reported malfunction was "R_{min} and R_{max} and bomb strobe weak, lost acquisition symbol."

AIRCRAFT DATA SUMMARY

1. UNIT

1a. Tail Number 7504 1b. Type of Fire Control APQ-109

2. DATA SOURCE

2a. Base Site Seymour-Johnson 2b. Sqdn. No. 335

2c. Hrs. End Monitor 6840 2d. Date 10/12/70

2e. Hrs. Start Monitor 4632 2f. Date 7/12/70

2g. Total Monitor Hrs. 2208

2h. ARINC Research Monitoring Personnel
M. Hutton, L. Larsen

3. DATA SUMMARY

3a. Flights 66 3b. Flight Hrs. 97.1 3c. MRA's 32 3d. Maint. Manhours 19.29

3e. FC Downtime Hrs. 189.8 3f. Admin. Time Hrs. 108.7 3g. Repair Time Hrs. 81.1

4. LRU SUMMARY, APQ-109

Type of Action	Rcvr/ Xmtr	Sync	P.S.	Cont. Ind.	Ind. (RO)	Ind. (Pilot)	Ant.	Cont. Radar	Cont. Ant.	Total
4a. Adjustments	1	1		6					1	9
4b. Repair/Replaced	2	5	3	5	1		1		2	19
4c. Total	3	6	3	11	1		1		3	28

4d. AN/APA-165 LRU Failures: 1

5. PARTS SUMMARY

5a. No. of MR's with Component Part Information Available 13.

5b. No. of MRA's Corrected by Adjustment Only 6.

5c. No. of Component Parts: Adjusted 20; Repaired/Replaced 9.

6. REMARKS: No defect found at A/C level on 1 MR. Reported malfunction was: "No XTALS Bits 1, 2, 3, 5."

AIRCRAFT DATA SUMMARY

1. UNIT

1a. Tail Number 7582 1b. Type of Fire Control APQ-109A

2. DATA SOURCE

2a. Base Site Seymour-Johnson 2b. Sqdn. No. 335

2c. Hrs. End Monitor 6504 2d. Date 9/28/70

2e. Hrs. Start Monitor 5640 2f. Date 8/23/70

2g. Total Monitor Hrs. 864

2h. ARINC Research Monitoring Personnel
M. Hutton, L. Larsen

3. DATA SUMMARY

3a. Flights 22 3b. Flight Hrs. 47.9 3c. MRA's 12 3d. Maint. Manhours 192.9

3e. FC Downtime Hrs. 154 3f. Admin. Time Hrs. 107.3 3g. Repair Time Hrs. 46.7

4. LRU SUMMARY, APQ-109

Type of Action	Rcvr/ Xmtr	Sync	P.S.	Cont. Ind.	Ind. (RO)	Ind. (Pilot)	Ant.	Cont. Radar	Cont. Ant.	Total
4a. Adjustments	1			1	1	1			3	7
4b. Repair/Replaced	3	1	1	1		1	4			11
4c. Total	4	1	1	2	1	2	4		3	18

4d. AN/APA-165 LRU Failures: 0

5. PARTS SUMMARY

5a. No. of MR's with Component Part Information Available 5.

5b. No. of MRA's Corrected by Adjustment Only 2.

5c. No. of Component Parts: Adjusted 10; Repaired/Replaced 3.

6. REMARKS

AIRCRAFT DATA SUMMARY

1. UNIT

1a. Tail Number 7625 1b. Type of Fire Control APQ-109A

2. DATA SOURCE

2a. Base Site Seymour-Johnson 2b. Sqdn. No. 335

2c. Hrs. End Monitor 6840 2d. Date 10/12/70

2e. Hrs. Start Monitor 5352 2f. Date 7/12/70

2g. Total Monitor Hrs. 1488

2h. ARINC Research Monitoring Personnel
M. Hutton, L. Larsen

3. DATA SUMMARY

3a. Flights 37 3b. Flight Hrs. 66.1 3c. MRA's 9 3d. Maint. Manhours 68.5

3e. FC Downtime Hrs. 55.1 3f. Admin. Time Hrs. 26.5 3g. Repair Time Hrs. 28.6

4. LRU SUMMARY, APQ-109

Type of Action	Rcvr/ Xmtr	Sync	P. S.	Cont. Ind.	Ind. (RO)	Ind. (Pilot)	Ant.	Cont. Radar	Cont. Ant.	Total
4a. Adjustments	2			2						4
4b. Repair/Replaced	1		2			1	2			6
4c. Total	3		2	2		1	2			10

4d. AN/APA-165 LRU Failures: 1

5. PARTS SUMMARY

5a. No. of MR's with Component Part Information Available 3.

5b. No. of MRA's Corrected by Adjustment Only 1.

5c. No. of Component Parts: Adjusted 3; Repaired/Replaced 4.

6. REMARKS

AIRCRAFT DATA SUMMARY

1. UNIT

1a. Tail Number 7627 1b. Type of Fire Control APQ-109A

2. DATA SOURCE

2a. Base Site Seymour-Johnson 2b. Sqdn. No. 335

2c. Hrs. End Monitor 6840 2d. Date 10/12/70

2e. Hrs. Start Monitor 5712 2f. Date 8/26/70

2g. Total Monitor Hrs. 1128

2h. ARINC Research Monitoring Personnel
M. Hutton, L. Larsen

3. DATA SUMMARY

3a. Flights 27 3b. Flight Hrs. 42.9 3c. MRA's 10 3d. Maint. Manhours 47

3e. FC Downtime Hrs. 60 3f. Admin. Time Hrs. 38.5 3g. Repair Time Hrs. 21.5

4. LRU SUMMARY, APQ-109

Type of Action	Rcvr/ Xmtr	Sync	P.S.	Cont. Ind.	Ind. (RO)	Ind. (Pilot)	Ant.	Cont. Radar	Cont. Ant.	Total
4a. Adjustments				4	1					5
4b. Repair/Replaced	2	1	3	1						7
4c. Total	2	1	3	5	1					12

4d. AN/APA-165 LRU Failures: 0

5. PARTS SUMMARY

5a. No. of MR's with Component Part Information Available 8.

5b. No. of MRA's Corrected by Adjustment Only 5.

5c. No. of Component Parts: Adjusted 11; Repaired/Replaced 5.

6. REMARKS

AIRCRAFT DATA SUMMARY

1. UNIT

1a. Tail Number 7635 1b. Type of Fire Control APQ-109A

2. DATA SOURCE

2a. Base Site Seymour-Johnson 2b. Sqdn. No. 335

2c. Hrs. End Monitor 6672 2d. Date 10/5/70

2e. Hrs. Start Monitor 5808 2f. Date 8/30/70

2g. Total Monitor Hrs. 864

2h. ARINC Research Monitoring Personnel
M. Hutton, L. Larsen

3. DATA SUMMARY

3a. Flights 30 3b. Flight Hrs. 48 3c. MRA's 6 3d. Maint. Manhours 66.7

3e. FC Downtime Hrs. 58.7 3f. Admin. Time Hrs. 42.6 3g. Repair Time Hrs. 16.1

4. LRU SUMMARY, APQ-109

Type of Action	Rcvr/ Xmtr	Sync	P.S.	Cont. Ind.	Ind. (RO)	Ind. (Pilot)	Ant.	Cont. Radar	Cont. Ant.	Total
4a. Adjustments				1	3				1	5
4b. Repair/Replaced	2	1		1		1	1	1		7
4c. Total	2	1		2	3	1	1	1	1	12

4d. AN/APA-165 LRU Failures: 0

5. PARTS SUMMARY

5a. No. of MR's with Component Part Information Available 4.

5b. No. of MRA's Corrected by Adjustment Only 3.

5c. No. of Component Parts: Adjusted 5; Repaired/Replaced 2.

6. REMARKS

AIRCRAFT DATA SUMMARY

1. UNIT

1a. Tail Number 7675 1b. Type of Fire Control APQ-109A

2. DATA SOURCE

2a. Base Site Seymour-Johnson 2b. Sqdn. No. 335

2c. Hrs. End Monitor 4872 2d. Date 7/22/70

2e. Hrs. Start Monitor 4800 2f. Date 7/19/70

2g. Total Monitor Hrs. 72

2h. ARINC Research Monitoring Personnel
M. Hutton, L. Larsen

3. DATA SUMMARY

3a. Flights 3 3b. Flight Hrs. 4.4 3c. MRA's 1 3d. Maint. Manhours 2.2

3e. FC Downtime Hrs. 4.8 3f. Admin. Time Hrs. 3.7 3g. Repair Time Hrs. 1.1

4. LRU SUMMARY, APQ-109

Type of Action	Rcvr/ Xmtr	Sync	P.S.	Cont. Ind.	Ind. (RO)	Ind. (Pilot)	Ant.	Cont. Radar	Cont. Ant.	Total
4a. Adjustments				1						1
4b. Repair/Replaced										
4c. Total				1						1

4d. AN/APA-165 LRU Failures: 0

5. PARTS SUMMARY

5a. No. of MR's with Component Part Information Available 1.

5b. No. of MRA's Corrected by Adjustment Only 1.

5c. No. of Component Parts: Adjusted 5; Repaired/Replaced 0.

6. REMARKS

AIRCRAFT DATA SUMMARY

1. UNIT

1a. Tail Number 7680 1b. Type of Fire Control APQ-109A

2. DATA SOURCE

2a. Base Site Seymour-Johnson 2b. Sqdn. No. 335

2c. Hrs. End Monitor 6048 2d. Date 9/9/70

2e. Hrs. Start Monitor 4632 2f. Date 7/12/70

2g. Total Monitor Hrs. 1416

2h. ARINC Research Monitoring Personnel
M. Hutton, L. Larsen

3. DATA SUMMARY

3a. Flights 41 3b. Flight Hrs. 58.2 3c. MRA's 18 3d. Maint. Manhours 116.2

3e. FC Downtime Hrs. 138.6 3f. Admin. Time Hrs. 81.9 3g. Repair Time Hrs. 56.7

4. LRU SUMMARY, APQ-109

Type of Action	Rcvr/ Xmtr	Sync	P.S.	Cont. Ind.	Ind. (RO)	Ind. (Pilot)	Ant.	Cont. Radar	Cont. Ant.	Total
4a. Adjustments		2		10	4	1	2		1	20
4b. Repair/Replaced	1	1	1	3	3	1		1	2	13
4c. Total	1	3	1	13	7	2	2	1	3	33

4d. AN/APA-165 LRU Failures: 0

5. PARTS SUMMARY

5a. No. of MR's with Component Part Information Available 12.

5b. No. of MRA's Corrected by Adjustment Only 10.

5c. No. of Component Parts: Adjusted 45; Repaired/Replaced 3.

6. REMARKS

AIRCRAFT DATA SUMMARY

1. UNIT

1a. Tail Number 7745 1b. Type of Fire Control APQ-109A

2. DATA SOURCE

2a. Base Site Seymour-Johnson 2b. Sqdn. No. 335

2c. Hrs. End Monitor 6840 2d. Date 10/12/70

2e. Hrs. Start Monitor 4656 2f. Date 7/13/70

2g. Total Monitor Hrs. 2184

2h. ARINC Research Monitoring Personnel
M. Hutton, L. Larsen

3. DATA SUMMARY

3a. Flights 61 3b. Flight Hrs. 94.4 3c. MRA's 15 3d. Maint. Manhours 105

3e. FC Downtime Hrs. 81.5 3f. Admin. Time Hrs. 43.3 3g. Repair Time Hrs. 38.2

4. LRU SUMMARY, APQ-109

Type of Action	Rcvr/ Xmtr	Sync	P.S.	Cont. Ind.	Ind. (RO)	Ind. (Pilot)	Ant.	Cont. Radar	Cont. Ant.	Total
4a. Adjustments	1	2		2	1			1		7
4b. Repair/Replaced	1	4				1	2			8
4c. Total	2	6		2	1	1	2	1		15

4d. AN/APA-165 LRU Failures: 2

5. PARTS SUMMARY

5a. No. of MR's with Component Part Information Available 5.

5b. No. of MRA's Corrected by Adjustment Only 4.

5c. No. of Component Parts: Adjusted 6; Repaired/Replaced 2.

6. REMARKS

AIRCRAFT DATA SUMMARY

1. UNIT

1a. Tail Number 7746 1b. Type of Fire Control APQ-109A

2. DATA SOURCE

2a. Base Site Seymour-Johnson 2b. Sqdn. No. 335

2c. Hrs. End Monitor 6840 2d. Date 10/12/70

2e. Hrs. Start Monitor 4632 2f. Date 7/12/70

2g. Total Monitor Hrs. 2208

2h. ARINC Research Monitoring Personnel
M. Hutton, L. Larsen

3. DATA SUMMARY

3a. Flights 71 3b. Flight Hrs. 113.8 3c. MRA's 23 3d. Maint. Manhours 123.8

3e. FC Downtime Hrs. 118.6 3f. Admin. Time Hrs. 67.4 3g. Repair Time Hrs. 51.2

4. LRU SUMMARY, *APQ-109*

Type of Action	Rcvr/ Xmtr	Sync	P.S.	Cont. Ind.	Ind. (RO)	Ind. (Pilot)	Ant.	Cont. Radar	Cont. Ant.	Total
4a. Adjustments	2	4		5					2	13
4b. Repair/Replaced	4		2	2			2			10
4c. Total	6	4	2	7			2		2	23

4d. AN/APA-165 LRU Failures: 0

5. PARTS SUMMARY

5a. No. of MR's with Component Part Information Available 11.

5b. No. of MRA's Corrected by Adjustment Only 9.

5c. No. of Component Parts: Adjusted 18; Repaired/Replaced 3.

6. REMARKS: No defect found at A/C level on 1 MR. Reported malfunction was: "breaks lock-on, antenna slams".

C02-01-1-1094

AIRCRAFT DATA SUMMARY

1. UNIT

1a. Tail Number 7589 1b. Type of Fire Control APQ-109A

2. DATA SOURCE

2a. Base Site S-J 2b. Sqdn. No. 335

2c. Hrs. End Monitor 6840 2d. Date 10/12/70

2e. Hrs. Start Monitor 4632 2f. Date 7/12/70

2g. Total Monitor Hrs. 2280

2h. ARINC Research Monitoring Personnel
Hutton & Larsen

3. DATA SUMMARY

3a. Flights 63 3b. Flight Hrs. 82.5 3c. MRA's 27 3d. Maint. Manhours 291.9

3e. FC Downtime Hrs. 241.6 3f. Admin. Time Hrs. 118.5 3g. Repair Time Hrs. 123.1

4. *LRU SUMMARY, APQ-109*

Type of Action	Rcvr/ Xmtr	Sync	P. S.	Cont. Ind.	Ind. (RO)	Ind. (Pilot)	Ant.	Cont. Radar	Cont. Ant.	Total
4a. Adjustments		5		5				1		11
4b. Repair/Replaced	4		5	2	1	2	2	1		17
4c. Total	4	5	5	7	1	2	2	2		28

4d. AN/APA-165 LRU Failures: 1

5. PARTS SUMMARY

5a. No. of MR's with Component Part Information Available 6.

5b. No. of MRA's Corrected by Adjustment Only 3.

5c. No. of Component Parts: Adjusted 16; Repaired/Replaced 4.

6. REMARKS: No defect found at A/C level on 1 MR. Reported malfunction was: "front scope persistancy low".

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APPENDIX B
FCS MAINTENANCE DATA BY SQUADRON

SUMMARY 1: 335th SQUADRON, SEYMOUR-JOHNSON AIR FORCE BASE

Aircraft Tail No.	No. of MR's Where Piece-Part Info. Available	No. of Piece Parts Involved	Piece Part Corrective Actions		MRA's Corrected by Adjustment Only	
			No. Adjusted	No. Repaired/ Replaced	No.	Pct*
	①	②	③	④	⑤	⑥
244	12	27	22	5	9	75
261	4	9	8	1	3	75
266	12	34	27	7	6	50
271	11	33	20	13	7	63.6
588	0	0	0	0	0	0
708	4	4	0	4	0	0
777	3	4	1	3	1	33.3
956	13	30	27	3	10	76.9
7456	7	12	10	2	5	71.4
7469	5	10	10	0	5	100
7478	13	40	35	5	8	63.8
7487	12	33	25	8	6	50
7489	10	14	9	5	5	50
7490	11	42	35	7	9	81.8
7491	1	1	1	0	1	100
7500	5	10	9	1	4	80
7504	13	29	20	9	6	46.2
7582	5	13	10	3	2	40
7589	6	20	16	4	3	50
7625	3	7	3	4	1	33.3
7627	8	16	11	5	5	62.5
7635	4	7	5	2	3	75
7675	1	5	5	0	1	100
7680	12	48	45	3	10	83.3
7745	5	8	6	2	4	80
7746	11	21	18	3	9	81.8
TOTAL	191	477	378	99	123	64.4

*Percentage = ⑤ / ① x 100.

SUMMARY 2: 78th SQUADRON, WOODBRIDGE AIR FORCE BASE

Aircraft Tail No.	No. of MR's Where Piece-Part Info. Available	No. of Piece Parts Involved	Piece Part Corrective Actions		MRA's Corrected by Adjustment Only	
			No. Adjusted	No. Repaired/ Replaced	No.	Pct*
	①	②	③	④	⑤	⑥
272	2	2	1	1	1	50
673	2	4	4	0	2	100
681	5	8	2	6	1	20
687	0	0	0	0	0	0
692	0	0	0	0	0	0
696	1	4	0	4	0	0
702	1	3	0	3	0	0
710	1	1	0	1	0	0
711	2	3	3	0	2	100
712	1	1	1	0	1	100
714	0	0	0	0	0	0
721	1	1	1	0	1	100
731	1	1	1	0	1	100
735	5	12	4	8	1	20
736	0	0	0	0	0	0
738	1	2	0	2	0	0
739	2	5	4	1	1	50
748	0	0	0	0	0	0
749	2	3	0	3	0	0
756	1	1	1	0	1	100
759	0	0	0	0	0	0
765	0	0	0	0	0	0
767	1	1	0	1	0	0
776	2	2	1	1	1	50
788	0	0	0	0		
TOTAL	31	54	23	31	13	42

*Percentage = ⑤ / ① x 100.

SUMMARY 3: 335th SQUADRON, SEYMOUR-JOHNSON AIR FORCE BASE

Aircraft Tail No.	Maintenance Report Summary				Next Flight After Maintenance		
	Total	Confirmed APQ-109 Failures	Confirmed AN/APA-165 Failures	No Defect Found	OK	Failure, Same Problem	Failure, New Problem
	①	②	③	④	⑤	⑥	⑦
244	16	14	2	0	8	4	4
261	6	5	1	0	6	0	0
266	22	22	0	0	16	2	4
271	24	20	0	4	13	5	6
588	1	1	0	0	1	0	0
708	10	7	1	2	5	2	3
777	10	7	1	2	9	0	1
956	19	14	1	4	13	3	3
7456	15	12	0	3	10	1	4
7469	16	11	0	5	12	1	3
7478	19	18	0	1	15	1	3
7487	26	18	1	7	20	2	4
7489	18	17	0	1	11	3	4
7490	21	18	2	1	12	3	6
7491	2	1	0	1	2	0	0
7500	12	8	1	3	9	2	1
7504	32	22	1	9	18	5	9
7582	12	11	0	1	6	1	5
7589	27	22	1	4	20	5	2
7625	9	7	1	1	8	0	1
7627	10	10	0	0	8	1	1
7635	6	6	0	0	4	1	1
7675	1	1	0	0	1	0	0
7680	18	18	0	0	10	3	5
7745	15	10	2	3	12	2	1
7746	23	19	0	4	19	2	2
Totals	390	319	15	56	268	49	73

SUMMARY 4: 78th SQUADRON, WOODBRIDGE AIR FORCE BASE

Aircraft Tail No.	Maintenance Report Summary				Next Flight After Maintenance		
	Total	Confirmed APQ-109 Failures	Confirmed AN/APA-165 Failures	No Defect Found	OK	Failure, Same Problem	Failure, New Problem
	①	②	③	④	⑤	⑥	⑦
227	*						
272	3	2	1	0	3	0	0
673	2	2	0	0	1	0	1
681	6	6	0	0	4	0	2
687	1	0	0	1	1	0	0
692	0		(6 flights, no maintenance)				
696	3	1	0	2(1)	2	0	1
702	2	1	0	1	2	0	0
710	1	1	0	0	1	0	0
711	3	3	0	0	2	0	1
712	1	1	0	0	1	0	0
714	*						
721	1	1	0	0	1	0	0
731	1	1	0	0	1	0	0
735	6	6	0	0	4	0	2
736	0		(1 flight, no maintenance)				
738	2	2	0	0	2	0	0
739	8	5	0	3	5	0	3
748	2	2	0	0	1	0	1
749	2	2	0	0	2	0	0
756	7	2	0	5	4	2	1
759	1	1	0	0	1	0	0
765	*						
767	1	1	0	0	1	0	0
776	5	4**	1	1	3	2	0
788	0		(3 flights, no maintenance)				
Totals	58	44	2	13	42	4	12

*CASA

**A/C 776: both the 109 & the 165 bad on one MR.

(1) Includes one MR for APA-165

SUMMARY 5: 335th SQUADRON, SEYMOUR-JOHNSON AIR FORCE BASE

Aircraft Tail No.	Reliability/Maintainability Summary						
	Monitored Calendar Hours ①	Monitored Flights ②	Flight Hours ③	Avg. Flight Time ④	No. of Maint. Reports ⑤	Failure Rate* ⑥	MTBM** ⑦
244	2112	46	77.9	1.69	16	.3478	4.868
261	1392	27	38.7	1.43	6	.2222	6.450
266	2184	57	96.1	1.68	22	.3859	4.368
271	2088	50	80.9	1.61	24	.4800	3.370
588	72	5	5.4	1.08	1	.2000	5.400
708	864	27	43	1.59	10	.3703	4.300
777	2208	55	117.6	2.13	10	.1818	11.760
956	2208	55	103.4	1.88	19	.3454	5.442
7456	1920	60	100.8	1.66	15	.2500	6.720
7469	2208	49	80.7	1.64	16	.3265	5.043
7478	2016	58	112.2	1.93	19	.3275	5.905
7487	2160	71	121.4	1.70	26	.3661	4.669
7489	2208	66	105.2	1.59	18	.2727	5.844
7490	2040	52	73.5	1.41	21	.4038	3.500
7491	912	32	45.6	1.42	2	.0625	22.800
7500	2208	53	83.2	1.56	12	.2264	6.993
7504	2208	66	97.1	1.47	32	.4848	3.034
7582	864	22	47.9	2.17	12	.5454	3.991
7589	2208	63	82.5	1.30	27	.4285	3.055
7625	1488	37	66.1	1.78	9	.2432	7.344
7627	1128	27	42.9	1.58	10	.3703	4.290
7635	864	30	48	1.60	6	.2000	8.000
7675	72	3	4.4	1.46	1	.3333	4.400
7680	1416	41	58.2	1.41	18	.4340	3.233
7745	2184	61	94.4	1.54	15	.2459	6.293
7746	2208	71	113.8	1.60	23	.3239	4.947
Totals	43440	1184	1940.9	1.64	390	.3294	4.9767

*Failure per flight = ⑤/②

**Mean time between maintenance actions = ③/⑤

SUMMARY 6: 78th SQUADRON: WOODBRIDGE AIR FORCE BASE

Aircraft Tail No.	Reliability/Maintainability Summary						
	Monitored Calendar Hours ①	Monitored Flights ②	Flight Hours ③	Avg. Flight Time ④	No. of Maint. Reports ⑤	Failure Rate* ⑥	MTBM** ⑦
227	0	0					
272	668	20	37.9	1.895	3	.15	12.633
673		11	17.9	1.627	2	.1818	8.950
681		19	35	1.842	6	.3157	5.833
687		1	1	1.0	1	1.0	1.000
692		6	9.8	1.633	0	–	–
696		16	25.2	1.575	3	.1875	8.400
702		10	21.1	2.11	2	.2	10.550
710		17	30.6	1.8	1	.0588	30.600
711		13	22.9	1.761	3	.2307	7.633
712	668	7	7.8	1.114	1	.1428	7.800
714	0	0	0	0	0		
721	668	2	3.1	1.55	1	.5	3.100
731		17	26.7	1.57	1	.0588	26.700
735		13	22.4	1.723	6	.4615	3.733
736		1	0.8	.8	0		
738		4	7.7	1.925	2	.5	3.850
739		26	51.7	1.988	8	.3076	6.462
748		12	22.2	1.85	2	.1666	11.100
749		12	22.3	1.858	2	.1666	11.150
756		18	37.5	2.08	7	.3888	5.357
759	668	13	22.8	1.753	1	.0769	22.800
765	0	0	0	0	0		
767	668	6	13.2	2.20	1	.1667	13.200
776		24	39	1.625	5	.2083	7.800
788	668	3	4.7	1.566	0		
Totals	15364	271	483.3	1.783	58	.2140	8.3328

*Failure per flight = ⑤/②

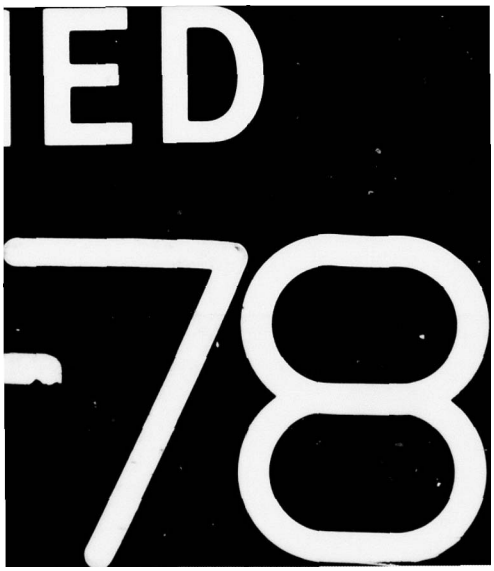
**Mean time between maintenance actions = ③/⑤

APPENDIX C
FCS LINE REPLACEABLE UNITS

The F4-D Fire Control System comprises the AN/APQ-109 and AN/APA-165 radar sets. These sets contain the following major LRUs:

APQ-109	Air Force Work Unit Code
Receiver-Transmitter RT-755/APQ-109	74790
Synchronizer, Electrical SN-377/APQ-109	74710
Control, Power Supply C-6412/APQ-109	74720
Control, Indicator C6&10/APQ-109	74780
Indicator, A2-EL-RNG, IP-772/APQ-109 (Radar Pilot)	74750
Indicator, A2-EL-RNG, IP-771/APQ-109 (Pilot)	74760
Antenna, AS-1694/APQ-109	74730
Control, Radar Set, C6411/APQ-109	74740
Control, Antenna, C6409/APQ-109 Trigger Assembly	74770
Control, Radar Set, Aux., C6437/APQ-109	747A0
Monitor Voltage 604R444G01	747E0
Mounting, MT-2133/AOQ-72	747C0
Rack, Equipment MT-2846/APQ-72 Pump Coolant	747B0
Dehydrator, Desiccant	747D0
APA-165	
Computer, Target Intercept, Cp-840	74A20
Transmitter, Radar T888/APA-157	74310
Modulator, MD-666	74A10
Tuning Drive TG-75/APA-128	404
Signal Horn 6E1	405
Direction Coupler 60C1 (6.5 db)	406
Direction Coupler 60C2 (17 db)	407
Direction Coupler 60C3 (10 db)	408
Coax Splitting Tee 6CP1	409
Pseudo Mod. Tee 621	410

The APQ-109A is identical to the APQ-109 except for the Indicator Control Unit (ICU), work unit code 7478D. The ICU of the APQ-109A has been modified to incorporate additional video processing capabilities. Except where noted, all references to the APQ-109 in this report also apply to the APQ-109A.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